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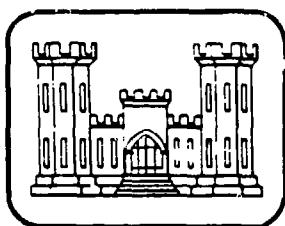
SUSQUEHANNA RIVER BASIN
TRIBUTARY OF CHOCONUT CREEK, SUSQUEHANNA COUNTY
PENNSYLVANIA

LAKE TIMBERLINE DAM

NDI No. PA00977
PennDER No. 58-125
Dam Owner: Richard O'Reilly



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
PACW 31-81-C-001



prepared for

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers
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AUGUST 1981

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PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Lake Timberline Dam, Susquehanna County, Pennsylvania
NDI No. PA 00977, PennDER No. 58-125
Tributary of Choconut Creek
Inspected 30 March 1981

ASSESSMENT OF
GENERAL CONDITIONS

Lake Timberline Dam is owned by Richard O'Reilly and is classified as a "Low" hazard - "Small" size dam. The dam was found to be in fair overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway capacity is less than the peak inflow to the impoundment during the 100-year flood. A spillway design flood (SDF) in the range of the 50-year flood to the 100-year flood is required for Lake Timberline Dam. The 100-year flood was chosen as the SDF. The spillway is therefore considered "Inadequate." It is recommended that the owner immediately provide adequate spillway capacity.

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

- 1) Provide adequate spillway capacity.
- 2) Fill and seed the eroded areas at the downstream ends of the spillway training walls.
- 3) Place riprap above and below normal pool level on the upstream slope of the embankment.
- 4) Monitor the seep near the outlet pipe at regular intervals and during periods of high reservoir levels for turbidity and/or increase in flow, which may indicate potential for the piping of embankment material. If turbidity and/or increased flows are noted, a qualified geotechnical engineer should be retained to further evaluate the seepage and to recommend remedial measures.
- 5) Repair the concrete headwall at the downstream end of the outlet pipe.

LAKE TIMBERLINE DAM

- (6) Repair or remove the foot bridge across the spillway.
- (7) Cut all trees at the toe of the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam.

Submitted by:

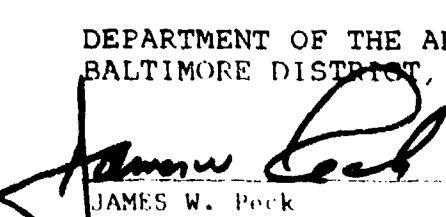
MICHAEL BAKER, JR., INC.


John A. Dziubek
Engineering Manager-Geotechnical

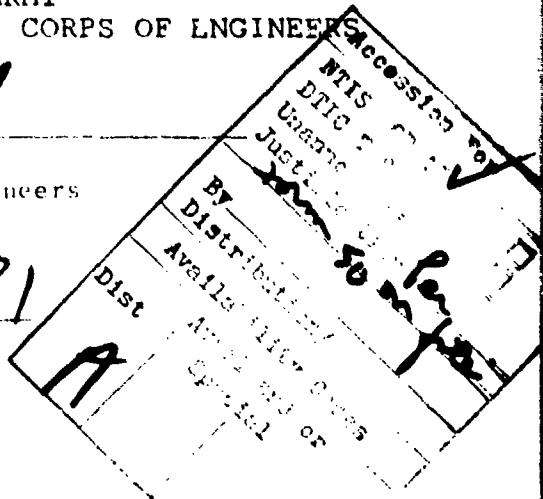
Date: 20 August 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS


James W. Peck
Colonel, Corps of Engineers
District Engineer

Date: 31 Aug 81



LAKE TIMBERLINE DAM



Overall View of Upstream Face of Dam From Right Abutment



Overall View of Downstream Face of Dam From Left Abutment

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE TIMBERLINE DAM
NDI No. PA 00977, PennDER No. 58-125

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.
- b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances - Lake Timberline Dam is an earthfill embankment 201 feet long and 12.6 feet high. The embankment has a crest width of 15 feet and side slopes of 0.6H:1V (Horizontal to Vertical) upstream (above normal pool level) and 1H:1V downstream (located near the outlet pipe), and the remaining areas of the downstream slope are approximately 2H:1V. The upstream face of the embankment is protected with riprap. Plans available for the dam show that a cut-off trench extends the entire length of the embankment. It has a bottom width of 8 feet, a top width of 10 feet and a depth of 5 feet below the upstream toe of the embankment.

The spillway, located near the center of the embankment, consists of a concrete broad-crested weir 30.7 feet long (perpendicular to the direction of flow). Concrete spillway training walls extend 1.6 feet above the crest of the weir.

The outlet works consist of an 18-inch diameter corrugated metal pipe encased in 6 inches of concrete with two 5 foot square - 8 inch wide anti-seep collars. A metal sliding gate valve on the upstream slope controls the submerged intake of the outlet works.

- b. Location → Lake Timberline Dam is located on an unnamed tributary to Choconut Creek in Silver Lake Township, Susquehanna County, Pennsylvania. The dam is approximately 2 miles north of Forest Lake.

The coordinates of the dam are N 41° 55.0' and W 75° 58.6'.

The dam can be found on the USGS 7.5 minute topographic quadrangle, Laurel Lake, Pennsylvania.

- c. Size Classification - The height of the dam is 12.6 feet. Storage at the top of the dam [Elevation 1418.6 feet Mean Sea Level (ft. M.S.L.)] is 182 acre-feet. Therefore, the dam is in the "Small" size category.
- d. Hazard Classification - If the dam should fail, economic damage is likely to result to one home and 3 unoccupied buildings 5600 feet downstream from the dam and 4 to 8 feet above the streambed. Damage to the Township Road 3150 feet downstream from the dam is also likely. Loss of life is considered unlikely; therefore, the dam is considered to be in the "Low" hazard category.
- e. Ownership - The dam is owned by Richard O'Reilly, RD #1, Friendsville, Pennsylvania 18818.
- f. Purpose of Dam - The impoundment created by the dam is used for recreation and fishing. 7
- g. Design and Construction History - Lake Timberline was designed by L. F. Burlein, P.E., of Honesdale, Pennsylvania, in 1957. The dam was constructed in 1958 and the contractor was H. D. Griffiths of Montrose, PA.
- h. Normal Operational Procedures - The reservoir is typically maintained at the spillway crest, Elevation 1417.0 ft. M.S.L.

1.3 PERTINENT DATA

- a. Drainage Area (square miles) - 1.28*
- b. Discharge at Dam Site (c.f.s.) -
Maximum Flood - Unknown
Spillway Capacity at Maximum Pool
(El. 1418.6 ft. M.S.L.) - 190.0

*Planimetered from the Laurel Lake, Pennsylvania, USGS 7.5 minute topographic quadrangle.

c.	<u>Elevation*</u> (feet above Mean Sea Level [ft. M.S.L.]) -	
	Design Top of Dam -	1416.0
	Minimum Top of Dam -	1418.6
	Maximum Design Pool -	Unknown
	Spillway Crest -	1417.0
	Toe of Dam -	1406.0
	Maximum Tailwater of Record -	Unknown
d.	<u>Reservoir (feet) -</u>	
	Length of Maximum Pool (El. 1418.6 ft. M.S.L.) -	1800.0
	Length of Normal Pool (El. 1417.0 ft. M.S.L.) -	1700.0
e.	<u>Storage (acre-feet) -</u>	
	Top of Dam (El. 1418.6 ft. M.S.L.) -	182.0
	Normal Pool (El. 1417.0 ft. M.S.L.) -	142.0
f.	<u>Reservoir Surface (acres) -</u>	
	Top of Dam (El. 1418.6 ft. M.S.L.) -	22.70
	Normal Pool (El. 1417.0 ft. M.S.L.) -	21.12
g.	<u>Dam -</u>	
	Type -	Earthfill
	Total Length (feet) -	201.0
	Height (feet) - Design -	10.0
	Field -	12.6
	Top Width (feet) -	15.0
	Side Slopes - Upstream - Design -	2H:1V
	Field - Varies from 0.6H:1V to 2H:1V	
	Downstream - Design -	2H:1V
	Field - Varies from 1H:1V to 2H:1V	
	Zoning -	None
	Impervious Core -	None
	Cut-off - A cut-off trench was designed for installation along the up- stream toe of the embankment. The trench was designed 5 feet deep with a bottom width of 8 feet.	
	Drains -	None

*All elevations are referenced to the spillway crest, El. 1417.0 ft. M.S.L., as estimated from the USGS 7.5 minute topographic quadrangle, Laurel Lake, Pennsylvania.

- h. Diversion and Regulating Tunnels - None
- i. Spillway -
- Type - Concrete broad-crested weir
Location - Center of embankment
Length of Crest Perpendicular to
Flow (feet) - 30.7
Crest Elevation (ft. M.S.L.) - 1417.0
Gates - None
- Downstream Channel - Rock lined with a
6-foot diameter culvert 75 feet
downstream.
- j. Outlet Works - The outlet works consist of
an 18-inch corrugated metal pipe with two
5 ft. by 5 ft. anti-seep collars. A sliding
gate valve, located on the upstream side
of the crest, controls the submerged intake
of the outlet works.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Information reviewed for preparation of this report consisted of the Pennsylvania Department of Environmental Resources' (PennDER) File No. 58-125. This included:

- 1) The permit application to the Commonwealth of Pennsylvania Water and Power Resources Board from Richard O'Reilly, owner of the dam (dated 5 August 1957).
- 2) Cross sections of the reservoir and the earth embankment as proposed by Mr. L. F. Burlein, Registered Engineer. The reference datum for these drawings is unknown.
- 3) The permit issued by the Water and Power Resources Board allowing construction of the dam (dated 12 August 1957).
- 4) The final construction inspection report prepared by a representative of PennDER stating that the work appeared satisfactory but that the wastewater channel had not been paved with riprap. (Dated 20 November 1961.)
- 5) The latest inspection report, dated 17 August 1965, which was filed by PennDER, Division of Dams and Encroachments, stating that the general appearance of the dam was very good.

2.2 CONSTRUCTION

The dam was constructed in 1958. The contractor was H. D. Griffiths of Montrose, PA.

2.3 OPERATION

No formal procedures are followed for operating the dam and reservoir. The spillway is uncontrolled and the reservoir is typically at the spillway crest level.

2.4 EVALUATION

- a. Availability - The information reviewed is readily available from PennDER File No. 58-125.

- b. Adequacy - The information available, combined with the visual inspection measurements and observations, is considered adequate for a Phase I Inspection of this dam.
- c. Validity - There is no reason at the present time to doubt the validity of the available engineering data. However, observations and measurements performed during the visual inspection indicated a few deviations from the design drawings. These are:
 - 1) The spillway crest has been raised and made a broad-crested weir.
 - 2) There is no wheel on the crest of the dam with which to control the gate for the outlet pipe.
 - 3) A foot bridge has been installed across the spillway.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General - The dam was found to be in fair overall condition at the time of inspection on 30 March 1981. No unusual weather conditions were experienced during the inspection. Noteworthy deficiencies observed during the visual inspection are described briefly in the following paragraphs. The complete visual inspection checklist, field sketch, top of dam profile, and typical cross-section are presented in Appendix A.
- b. Embankment - Erosion was observed around both downstream ends of the spillway training walls. Minor erosion was also noted along the upstream face of the embankment at normal pool level. Brush and some small trees are growing on the downstream face of the embankment. Clear seepage (approximately 1 g.p.m.) was flowing from the toe of the embankment near the outlet pipe. The embankment slopes appeared to be approximately 2H:1V with the slopes near the outlet pipe appearing to be 1H:1V.
- c. Appurtenant Structures - The concrete headwall at the downstream end of the outlet pipe is deteriorated. The outlet end of the outlet pipe appears to be at a higher elevation than the entrance to the pipe. The foot bridge across the spillway is in poor condition.
- d. Reservoir Area - The reservoir slopes are moderate and no signs of instability were observed. Sedimentation did not appear to be a problem.
- e. Downstream Channel - The downstream channel has mild slopes. The channel passes through a 6-foot culvert under a private road 75 feet downstream from the dam. Located 3150 feet downstream from the dam is a township road. One house and three unoccupied buildings are located 5600 feet downstream of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal procedures for operating the reservoir or evacuating the downstream area in case of an emergency. It is recommended that formal emergency procedures be adopted, prominently displayed and furnished to all operating personnel.

4.2 MAINTENANCE OF DAM

There are no formal records of maintenance or formal procedures for evaluating the necessity of maintenance for the structure. It is recommended that formal inspection procedures be developed.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance is unscheduled. It is recommended that a formal operation and a preventive maintenance schedule be developed and implemented.

4.4 DESCRIPTION OF ANY WARNING SYSTEM

There is no warning system in the event of dam failure. It is recommended that an emergency warning system be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The current operational features are adequate for the purpose they serve. However, it is recommended that a formal maintenance and operations manual be prepared for the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data - No hydrologic or hydraulic design calculations are available for Lake Timberline Dam.
- b. Experience Data - No information concerning the effects of significant floods on the dam is available.
- c. Visual Observations - During the visual inspection, no problems were observed which would indicate that the dam and appurtenant facilities could not perform satisfactorily during a flood event.
- d. Overtopping Potential - Lake Timberline Dam is a "Small" size - "Low" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 50-year flood to the 100-year flood. The 100-year flood was chosen as the SDF.

Using material from "The Hydrologic Study - Tropical Storm Agnes" prepared by the Corps of Engineers New York District, the peak inflow to the impoundment for the 100-year flood was calculated to be 1390 c.f.s. The peak inflow to the impoundment for the 100-year flood was also calculated to be 680 c.f.s., using material from "Water Resources Bulletin, Bulletin No. 13, Floods in Pennsylvania", prepared by the Department of Environmental Resources, Commonwealth of Pennsylvania. Averaging these two methods produced a peak inflow of 1030 c.f.s., which was used in this analysis.

The spillway capacity at the minimum top of dam is 190 c.f.s., which is approximately 19 percent of the peak inflow to the impoundment.

- e. Spillway Adequacy - As outlined in the above analysis, the inflow to the impoundment during the 100-year flood is greater than the spillway capacity; therefore, the spillway is considered "Inadequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations - Seepage was observed exiting near the outlet pipe discharge. This area should be monitored in future inspections for an increase in flow and/or turbidity.
- b. Design and Construction Data - Calculations of slope and structural stability were not available for review. The dam cross-section indicates a downstream slope of 1H:1V. This slope is present only at the outlet location and the remaining areas of the downstream slope are approximately 2H:1V as designed. The slopes have had a history of satisfactory performance. In view of the modest height of the dam, a history of satisfactory performance of its slopes, and no signs of distress observed during the visual inspection, no further stability analysis is deemed necessary.
- c. Operating Records - Nothing in the operational information indicates concern relative to the structural stability of the dam.
- d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.
- e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted since the dam is considered to be structurally stable.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- A. Safety - Lake Timberline Dam was found to be in fair overall condition at the time of inspection. Lake Timberline Dam is a "Low" hazard - "Small" size dam requiring a spillway capacity in the range of the 50-year flood to the 100-year flood. The 100-year flood was chosen as the SDF. As presented in Section 5, the spillway capacity is less than the peak inflow to the impoundment during the 100-year flood. Therefore, the spillway is considered "Inadequate."
- b. Adequacy of Information - The information available and the observations and measurements made during the field inspection are considered sufficient for this Phase I Inspection Report.
- c. Urgency - The owner should immediately initiate the action discussed in paragraph 7.2.
- d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analysis performed in connection with this Phase I Inspection Report has indicated the need for additional spillway capacity. It is recommended that the owner provide adequate spillway capacity.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed certain items of remedial work which should be performed by the owner without delay. These include:

- 1) Provide adequate spillway capacity.
- 2) Fill and seed the eroded areas at the downstream ends of the spillway training walls.
- 3) Place riprap above and below normal pool level on the upstream slope of the embankment.
- 4) Monitor the seep near the outlet pipe at regular intervals and during periods of high reservoir levels for turbidity and/or increase in flow, which may indicate potential for the piping of embankment material. If turbidity and/or increased flows are noted, a qualified

geotechnical engineer should be retained to further evaluate the seepage and to recommend remedial measures.

- 5) Repair the concrete headwall at the downstream end of the outlet pipe.
- 6) Repair or remove the footbridge across the spillway.
- 7) Cut all trees at the toe of the embankment at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rainfall, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operational procedures and records be developed and implemented. These should be included in a formal maintenance and operations manual for the dam.

APPENDIX A

**VISUAL INSPECTION CHECK LIST, FIELD SKETCH,
TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION**

A-1

Check List
Visual Inspection
Phase 1

Name of Dam Lake	<u>Timberline</u>	Dam	County	<u>Susquehanna</u>	State	<u>Pennsylvania</u>	Coordinates	Lat.	<u>N 41°55.0'</u>
NDI #	PA 00977								
PennDER #	58-125								
Date of Inspection	<u>30 March 1981</u>		Weather	<u>Rain</u>			Temperature	<u>60° F.</u>	

Pool Elevation at time of Inspection 1417.2 ft.* M.S.L. Tailwater at Time of Inspection 1408.4 ft. M.S.L.
*All elevations are referenced to the spillway crest, El. 1417.0 ft. M.S.L. as estimated from the USGS 7.5 minute topographic quadrangle, Laurel Lake, Laurel Lake, Pennsylvania.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Jeff L. Sawyer
Gary W. Todd

Owner's Representatives:

James G. Ulinski Recorder

A-2

Name of Dam: LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF
OBSERVATIONS

REMARKS OR RECOMMENDATIONS

LEAKAGE

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

DRAINS

WATER PASSAGES

FOUNDATION

CONCRETE/MASONRY DAMS - Not Applicable

A-3

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977
VISUAL EXAMINATION OF CONCRETE SURFACES

OBSERVATIONS

SURFACE CRACKS

STRUCTURAL CRACKING

REMARKS OR RECOMMENDATIONS

VERTICAL AND HORIZONTAL ALIGNMENT

MONOLITH JOINTS

CONSTRUCTION JOINTS

A-4

EMBANKMENT

Name of Dam LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF

OBSERVATIONS

SURFACE CRACKS

None observed

REMARKS OR RECOMMENDATIONS

**UNUSUAL MOVEMENT OR
CRACKING AT OR BEYOND
THE TOE**

None observed

**SLoughing or Erosion of
Embankment and Abutment
Slopes**

Erosion around both downstream ends
of the spillway training walls.
Minor erosion along the upstream
face at normal pool level.

Fill and seed areas of erosion.
Place erosion protection on the
upstream face of the embankment
above and below normal pool
level.

A-5

EMBANKMENT

Name of Dam LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF OBSERVATIONS

VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST

The horizontal and vertical alignment of the crest are good.

RIPRAP FAILURES

None observed

VEGETATION

Brush and some small trees are growing on the downstream face of the embankment.

Cut all trees and brush at ground level. All trees with a trunk diameter greater than 3-in. should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted and seeded.

EMBANKMENT

Name of Dam LAKE TIMBERLINE DAM
NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.	Clear seepage (approximately 1 g.p.m.) 2 ft. upstream from the downstream end of the outlet pipe.
ANY NOTICEABLE SEEPAGE	None	Monitor for turbidity and increase in flow.
STAFF GAGE AND RECORDER	None	
DRAINS	None observed	

OUTLET WORKS		VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
Name of Dam:	Lake Timberline Dam			
	NDI #PA 00977			
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet pipe is an 18-inch C.M.P. provided with upstream closure. The outlet pipe did not show signs of major deterioration.			Monitor seep in the future for increase in flow and/or turbidity.
INTAKE STRUCTURE	The intake is submerged. The valve stem is submerged off of the upstream crest of the dam.			
OUTLET STRUCTURE	The outlet pipe is encased in a concrete headwall. A clear seep (est. 1 g.p.m.) was flowing from the toe of the embankment 2 ft. upstream from the end of the pipe. The outlet end of the pipe appears to be at a higher elevation than the entrance to the pipe.			
OUTLET CHANNEL	Good condition.			
EMERGENCY GATE				

A-8

UNGATED SPILLWAY

Name of Dam: LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF **OBSERVATIONS** **REMARKS OR RECOMMENDATIONS**

CONCRETE WEIR No problems observed.

APPROACH CHANNEL No problems observed.

DISCHARGE CHANNEL

There is erosion around both sides of downstream end of training walls. The owner reports installing free training material to relieve pressure on the training walls.

BRIDGE AND PIERS

The footbridge is in poor condition. Repair or remove footbridge.

A-9

Name of Dam: LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		

APPROACH CHANNEL

DISCHARGE CHANNEL

BRIDGE AND PIERS

GATES AND OPERATION
EQUIPMENT

A-10

Name of Dam: Lake Timberline Dam

NDI #PA 00977

INSTRUMENTATION

VISUAL EXAMINATION

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

MONUMENTATION/SURVEYS

None

OBSERVATION WELLS

None

WEIRS

None

PIEZOMETERS

None

OTHER

None

A-11

RESERVOIR

Name of Dam: LAKE TIMBERLINE DAM

INDI #PA 00977

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

STOPPES

The reservoir slopes are mild and no problems were observed.

SEDIMENTATION

No problem observed.

A-12

DOWNSTREAM CHANNEL

Name of Dam: LAKE TIMBERLINE DAM

NDI #PA 00977

VISUAL EXAMINATION OF

**CONDITION
(OBSTRUCTIONS,
DEBRIS, ETC.)**

A private road is located immediately downstream with a 6-ft. diameter culvert.

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

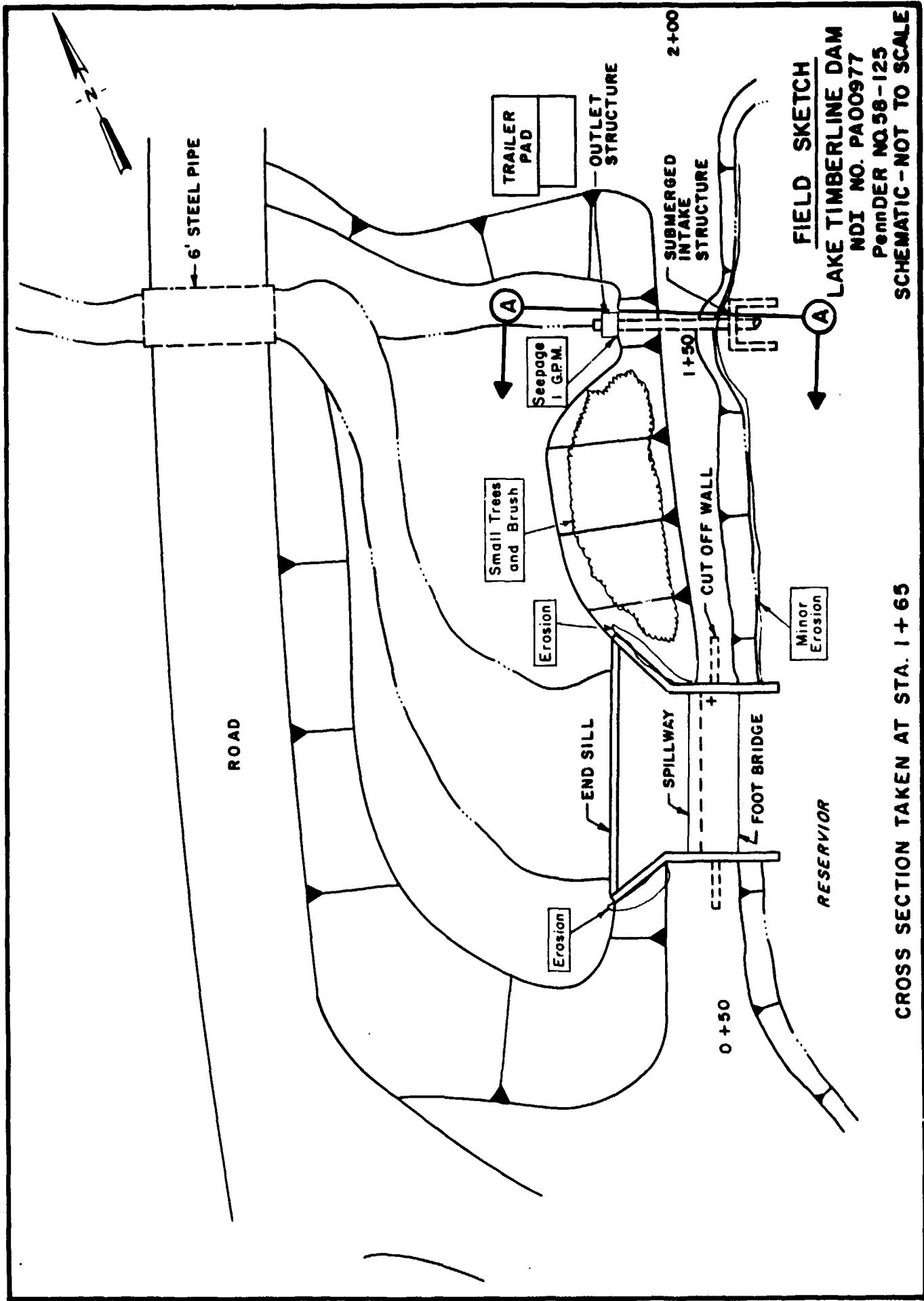
SLOPES

The downstream channel slopes at approximately 1.5 percent. The side slopes are mild.

**APPROXIMATE NO.
OF HOMES AND
POPULATION**

One home and 3 unoccupied buildings are located 5600 ft. downstream from the dam. These structures are from 4 to 8 ft. above the stream bed. All of the structures are likely to suffer economic damages were the dam to fail.

FIELD SKETCH
LAKE TIMBERLINE DAM
NDI NO. PA00977
PENNDEER NO 38-125
SCHEMATIC - NOT TO SCALE



CROSS SECTION TAKEN AT STA. I + 65

MICHAEL BAKER, JR., INC.

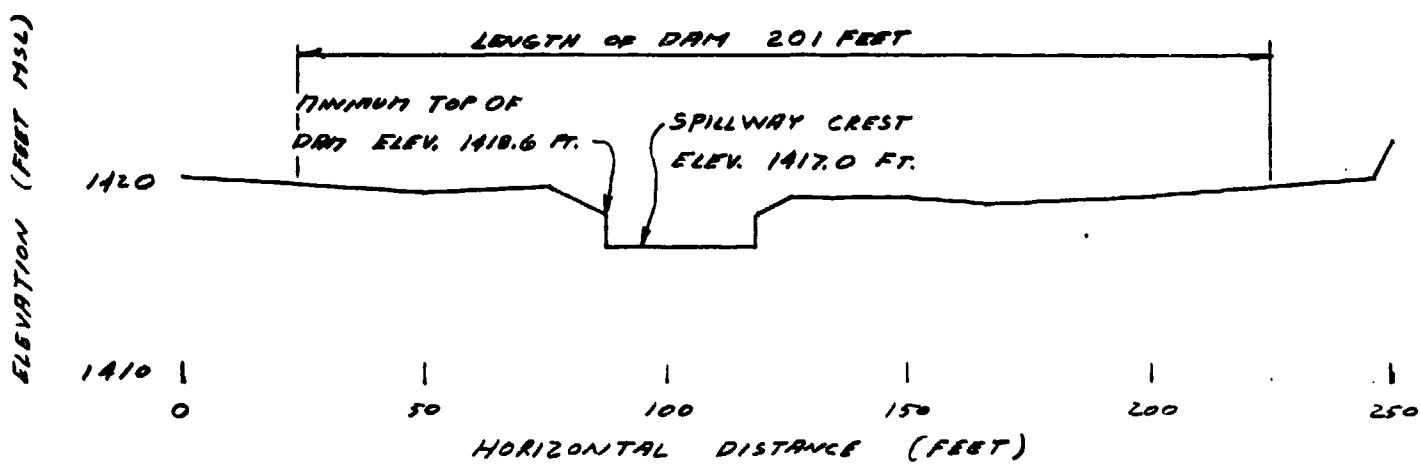
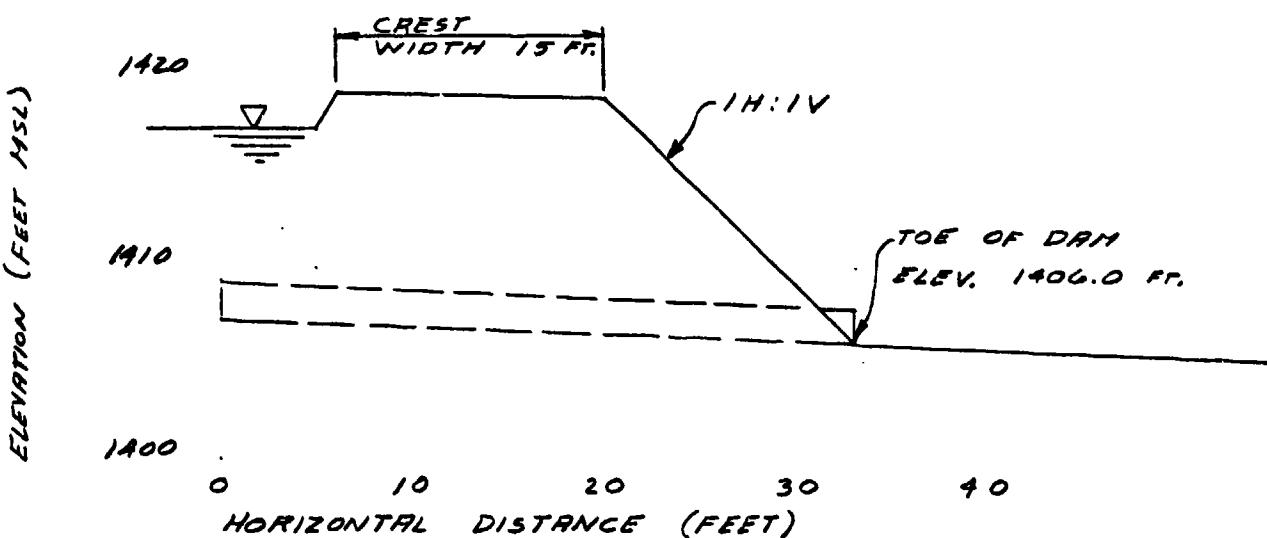
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

LAKE TIMBERLINE DAM

TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

DATE OF INSPECTION: 30 March 1981

TOP OF DAM PROFILE (LOOKING DOWNSTREAM)TYPICAL CROSS SECTION @ STATION 1+65

APPENDIX B
ENGINEERING DATA CHECK LIST

B-1

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: Lake Timberline Dam

NDI #PA 00977

ITEM

PLAN OF DAM

See Plate 4 of this report.

REGIONAL VICINITY MAP

A USGS 7.5' topographic quadrangle, Laurel Lake, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).

CONSTRUCTION HISTORY

The dam was designed by L. F. Burlein, P.E., in 1957. The dam was constructed in 1958. The contractor was H. D. Griffiths of Montrose, PA.

TYPICAL SECTIONS OF DAM

See Plate 5 of this report.

HYDROLOGIC/HYDRAULIC DATA

None available.

OUTLETS - PLAN

See Plate 7 of this report.

- DETAILS

See Plate 7 of this report.

- CONSTRAINTS

None available.

- DISCHARGE RATINGS

None available.

RAINFALL/RESERVOIR RECORDS

None available.

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

B-2

ITEM	REMARKS	
DESIGN REPORTS	None available.	
GEOLOGY REPORTS		No geology reports are available for the dam. See Appendix P for Regional Geology.
DESIGN COMPUTATIONS		No design computations are available.
HYDROLOGY & HYDRAULICS		
DAM STABILITY		
SEEPAGE STUDIES		
MATERIALS INVESTIGATIONS		No information available.
BORING RECORDS		
LABORATORY		
FIELD		
POST-CONSTRUCTION SURVEYS OF DAM		None performed.
BORROW SOURCES		No information available.

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

B-3

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	The spillway crest was raised by placing a concrete cap on the existing weir. The left downstream wingwall was replaced in 1978.
HIGH POOL RECORDS	None available.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None available.

Name of Dam: LAKE TIMBERLINE DAM
NDI #PA 00977

B-4

<u>ITEM</u>	<u>REMARKS</u>
SPILLWAY PLAN, SECTIONS, and DETAILS	See Plates 5 and 6 of this report.
OPERATING EQUIPMENT PLANS & DETAILS	None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.28 sq. mi. (primarily forested)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1417.0 ft. M.S.L.
(142 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1418.6 ft. M.S.L.
(182 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1418.6 ft. M.S.L. (Minimum top of dam)

SPILLWAY: _____

- a. Crest Elevation 1417.0 ft. M.S.L.
- b. Type concrete broad-crested weir
- c. Width of Crest Parallel to Flow 3.0 ft.
- d. Length of Crest Perpendicular to Flow 30.7 ft.
- e. Location Spillover center of embankment
- f. Number and Type of Gates None

OUTLET WORKS: _____

- a. Type 18-in. corrugated metal pipe with a metal slide gate on upstream end
- b. Location 50 ft. right of the spillway
- c. Entrance Inverts unknown
- d. Exit Inverts 1406.0 ft. M.S.L.
- e. Emergency Drawdown Facilities The outlet pipe serves as the drawdown facilities

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C
PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam

Top Photo - Overall View of Upstream Face of Dam from
(OV-T) Right Abutment

Bottom Photo - Overall View of Downstream Face of Dam
(OV-B) from Left Abutment

Photograph Location Plan

Photo 1 - View of Entrance to Spillway

Photo 2 - View Across Spillway

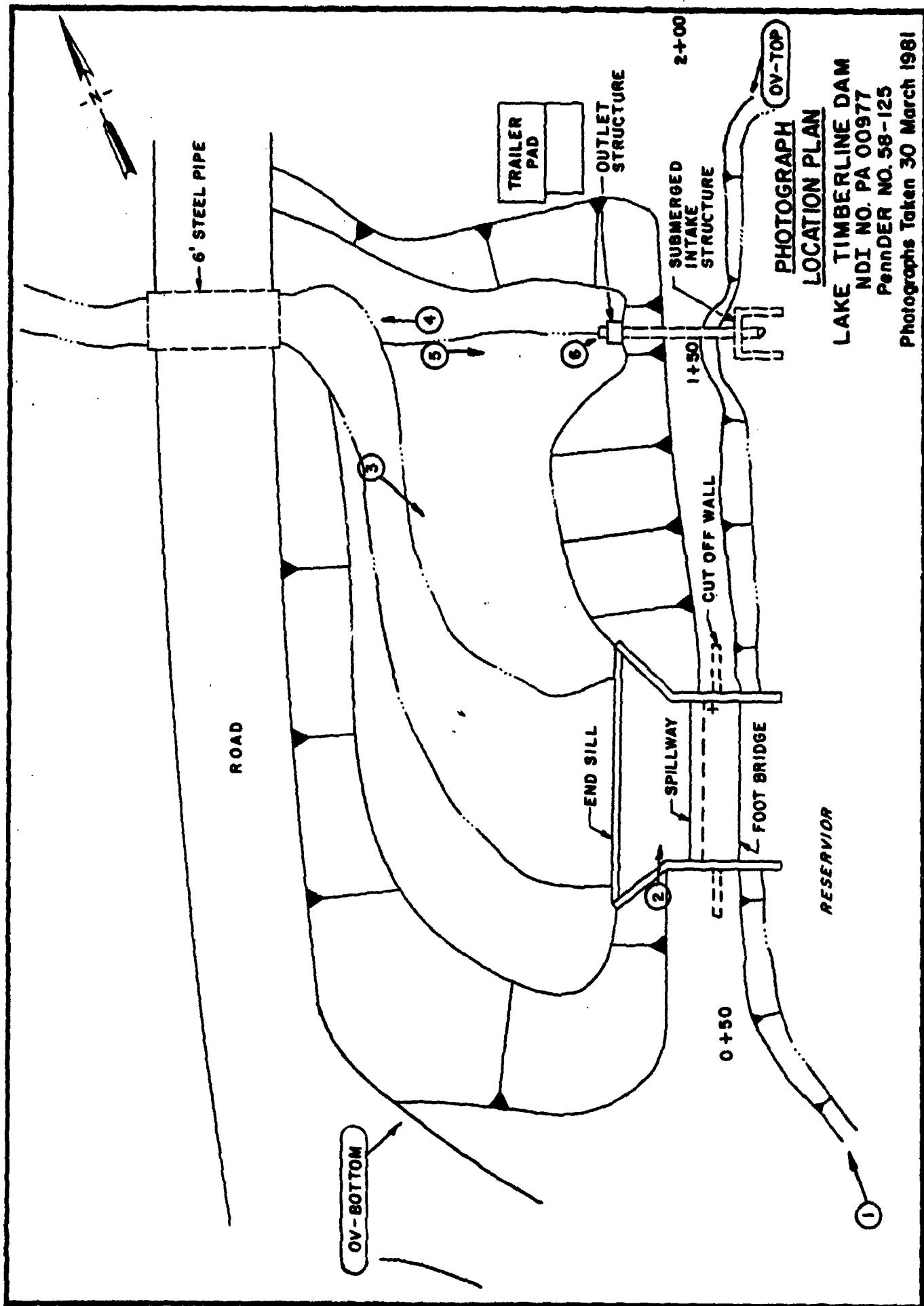
Photo 3 - View of Downstream Side of Spillway

Photo 4 - View of Road Culvert Immediately Downstream of Dam

Photo 5 - View of Discharge End of Outlet Pipe

Photo 6 - Close-up View of Discharge End of Outlet Pipe

Note: Photographs were taken on 30 March 1981.



LAKE TIMBERLINE DAM

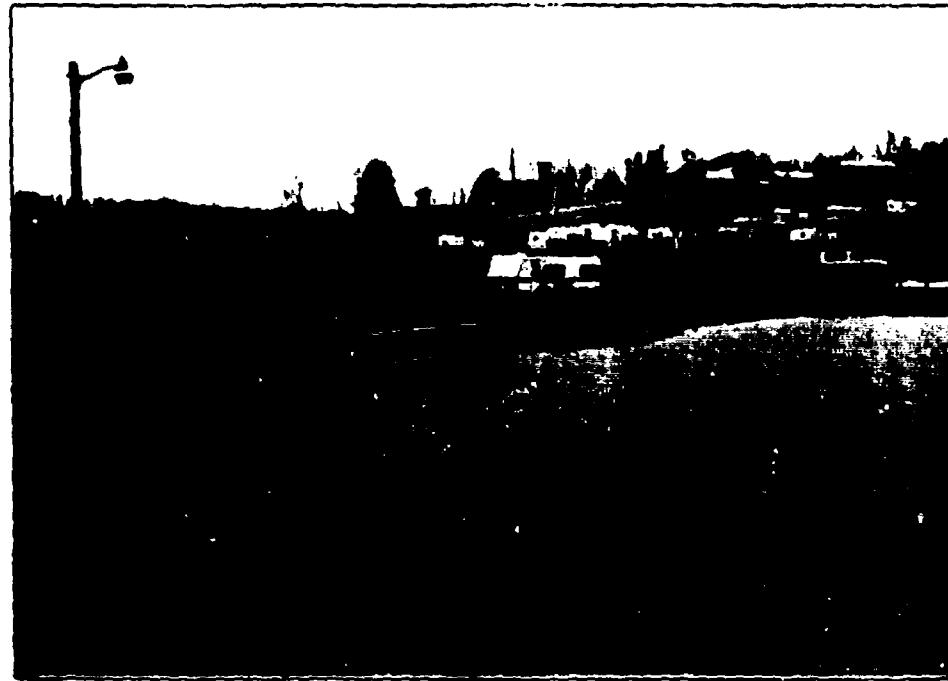


PHOTO 1. View of Entrance to Spillway

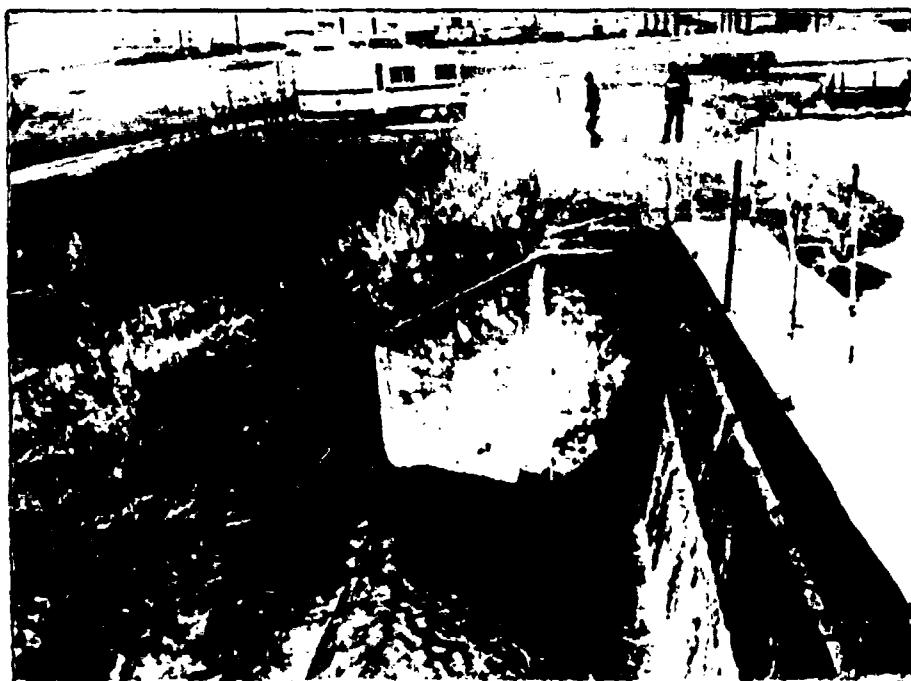


PHOTO 2. View Across Spillway

LAKE TIMBERLINE DAM

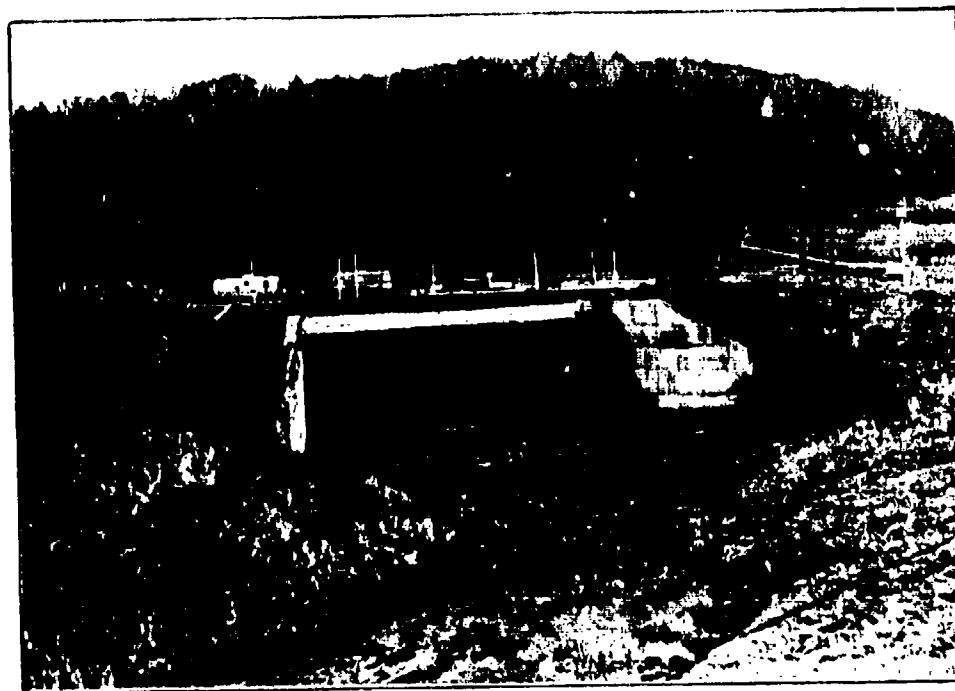


PHOTO 3. View of Downstream Side of Spillway



PHOTO 4. View of Road Culvert Immediately Downstream of Dam

LAKE TIMBERLINE DAM



PHOTO 5. View of Discharge End of Outlet Pipe

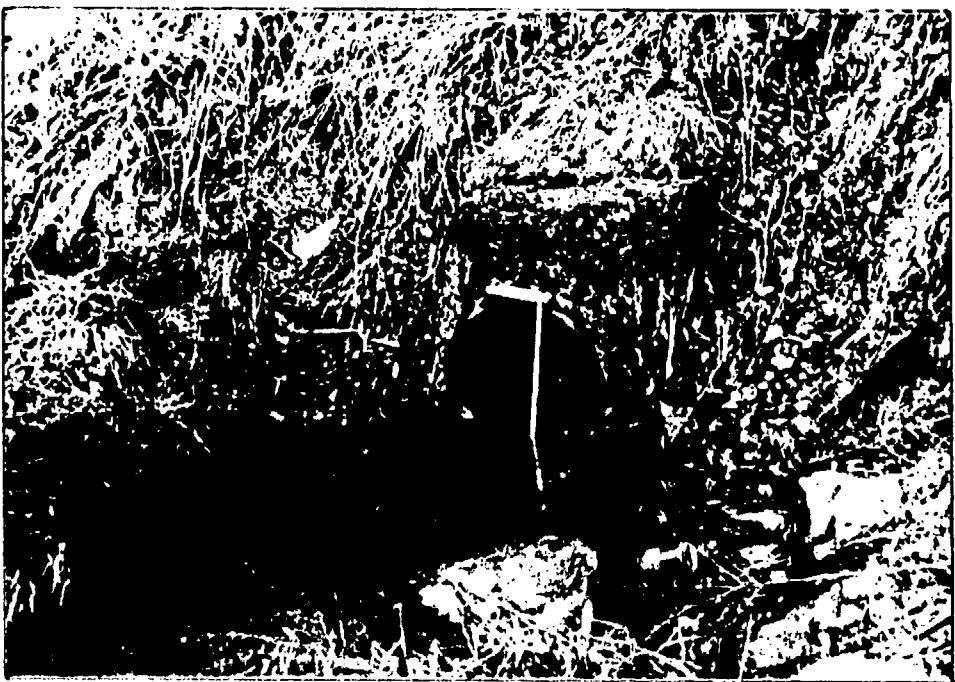


PHOTO 6. Close-up View of Discharge End of Outlet Pipe

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM S.O. No. _____
APPENDIX D - HYDROLOGIC AND Sheet No. _____ of _____
HYDRAULIC CALCULATIONS Drawing No. _____
Computed by GWT Checked by _____ Date _____

<u>SUBJECT</u>	<u>PAGE</u>
PREFACE	i
HYDRAULIC DATA	1
DRAINAGE AREA AND CENTROID MAP	2
TOP OF DAM PROFILE AND CROSS SECTION	3
SPILLWAY DISCHARGE RATING	4
100-YEAR DISCHARGE CALCULATION	5

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Conclusions presented herein pertain to present conditions. The effect of future development on the hydrology of the watershed has not been considered.

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Pa. Dam Insp.

S.O. No.

Sheet No. 1 of 6

Drawing No.

Lake Timberline Dam

HYDRAULIC DATA

Computed by GBD

Checked by GWT

Date 4/8/81

DRAINAGE AREA

$$\text{LAUREL LAKE QUAD.} - 2451.3 \frac{1}{3} = 817.1 \text{ Acres} = 1.28 \text{ mi}^2$$

SURFACE AREAS

$$\text{LAKE SURFACE @ EI. } 1417 - 0.69 \frac{1}{3} = 0.23 \text{ in}^2 = 21.12 \text{ Acres} = .033 \text{ mi}^2$$

$$\text{EI. } 1420 - 1.20 \frac{1}{3} = 0.40 \text{ in}^2 = 36.73 \text{ Acres} = .057 \text{ mi}^2$$

$$\text{EI. } 1440 - 1.98 \frac{1}{3} = 0.66 \text{ in}^2 = 60.61 \text{ Acres} = .094 \text{ mi}^2$$

WATERSHED LENGTHS

$$L = 7,867.2 \text{ ft.} = 1.49 \text{ mi.}$$

$$L_c = 2,481.6 \text{ ft.} = 0.47 \text{ mi.}$$

NORMAL POOL STORAGE

$$\text{STORAGE VOLUME} = \frac{1}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

$$A_1 = 19.6 \text{ Ac.}$$

$$A_2 = 21.12 \text{ Ac.}$$

$$h = 7$$

$$V = \frac{1}{3} (19.6 + 21.12 + \sqrt{(19.6)(21.12)})$$

$$V = 142 \text{ AC-FT}$$

TOP OF DAM STORAGE

$$\text{STORAGE VOLUME} = \frac{1}{3} (A_1 + A_2 + \sqrt{A_1 A_2})$$

$$A_1 = 19.6 \text{ Ac.}$$

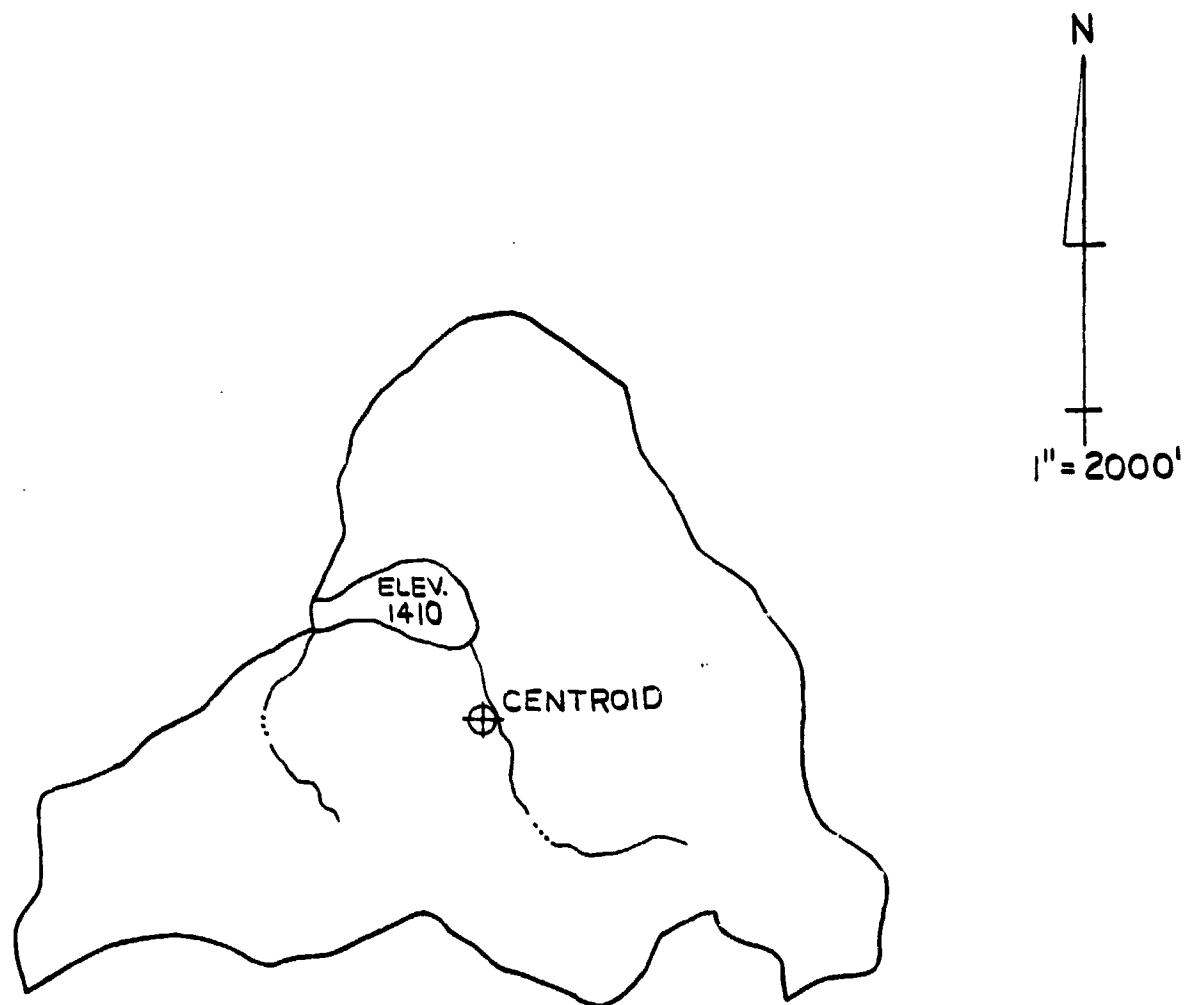
$$A_2 = 22.7 \text{ Ac.}$$

$$h = 8.6 \text{ FT}$$

$$V = \frac{8.6}{3} (19.6 + 22.7 + \sqrt{(19.6)(22.7)})$$

$$V = 182 \text{ AC-FT}$$

SHEET 2 OF 6



LAUREL LAKE QUAD.

LAKE TIMBERLINE DAM
DRAINAGE AREA AND CENTROID MAP

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TINNAKGINE DAM

S.O. No. _____

TOP OF DAM PROFILE AND

Sheet No. 3 of 6

TYPICAL CROSS SECTION

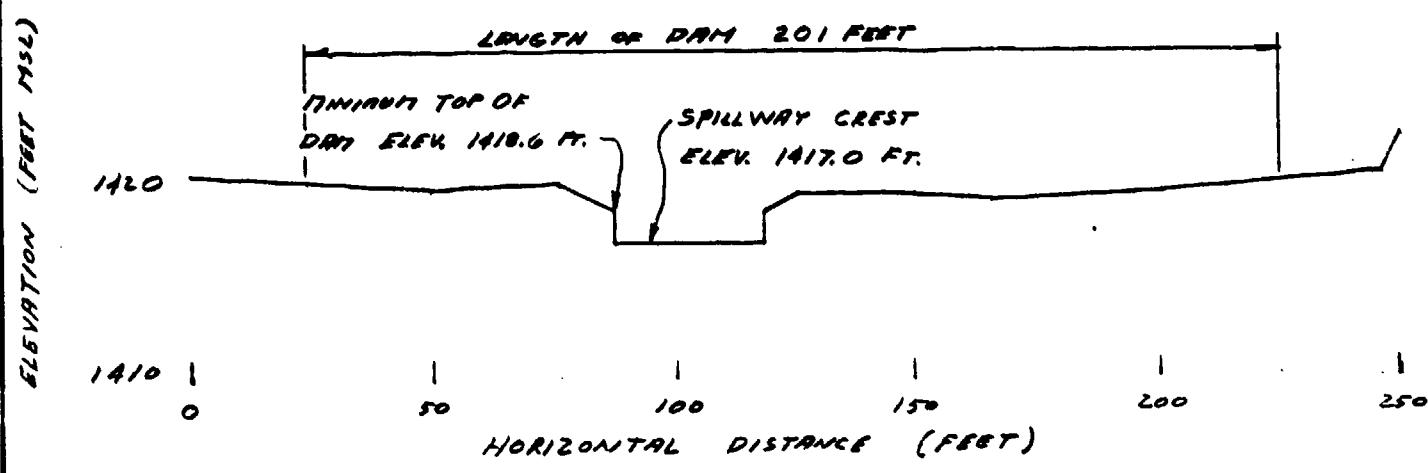
Drawing No. _____

Computed by GWT

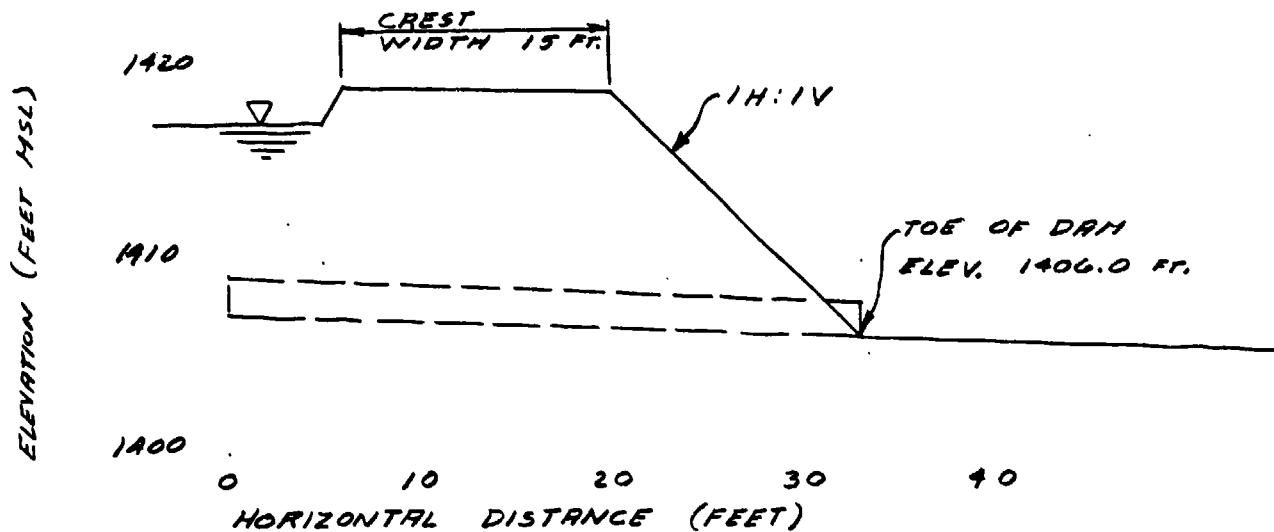
Checked by WAL

Date 3-30-81

TOP OF DAM PROFILE (LOOKING DOWNSTREAM)



TYPICAL CROSS SECTION @ STATION 1+65

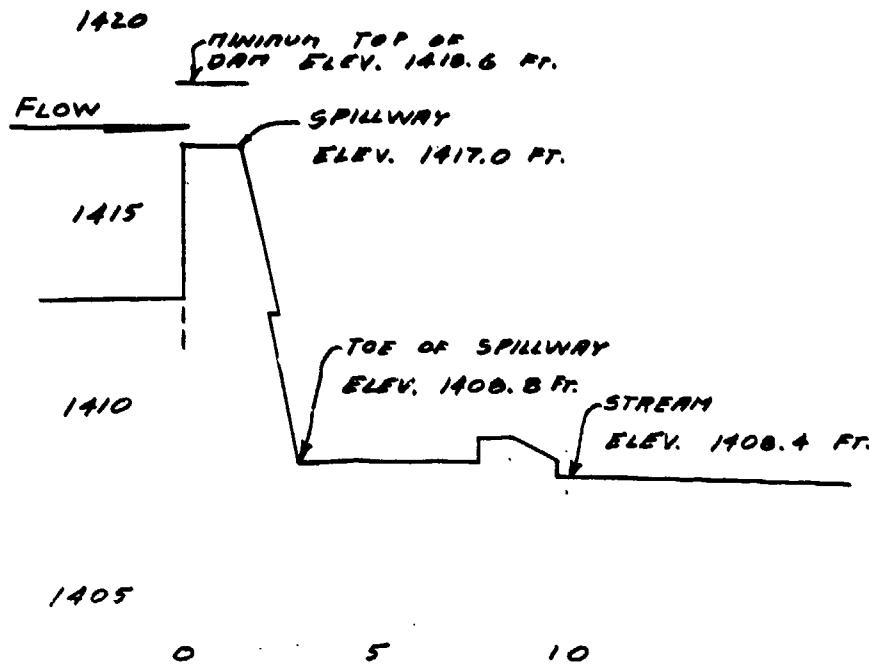


MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Lake Timberline Dam S.O. No. 1
Spillway Discharge Rating Sheet No. 4 of 6
Computed by GWT Checked by WDC Drawing No.
Date 3-30-71

SPILLWAY PROFILE



SPILLWAY DISCHARGE RATING

$$Q = CLH^{3/2}$$

C = 3.1 FROM BRATER & KING TABLE 5-3 PAGE 5-40

L = 30.7 FEET

H VARIES

SPILLWAY CAPACITY AT THE MINIMUM TOP OF DAM

$$Q = 3.1 (30.7)(1.6)^{3/2}$$

$$Q = 193 \text{ C.F.S.}$$

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LAKE TIMBERLINE DAM S.O. No. _____
100-YEAR DISCHARGE CALCULATION Sheet No. 5 of 6
Drawing No. _____
Computed by GUT Checked by WDV Date 1/7/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA = 1.28 SQ. MI.

① COMPUTE THE MEAN LOGARITHM

$$\log(Q_m) = C_m + 0.75 \log A$$

$\log(Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS

A = DRAINAGE AREA, SQ. MI. = 1.28

C_m = MAP COEFFICIENTS FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21 - Z.2.0

$$\begin{aligned} \log(Q_m) &= 2.20 + 0.75 (\log 1.28) \\ &= 2.2804 \end{aligned}$$

② COMPUTE STANDARD DEVIATION

$$s = C_s - 0.05 (\log A)$$

s = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS.

C_s = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.35

A = DRAINAGE AREA, SQ. MI., = 1.28

$$\begin{aligned} s &= 0.35 - 0.05 (\log 1.28) \\ &= 0.3446 \end{aligned}$$

③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.225

④ $\log(Q_{100}) = \log(Q_m) + K(p,g)s$

$K(p,g)$ = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY"

$$\log(Q_{100}) = 2.2804 + 2.50(0.3446)$$

$$Q_{100} = 1,386 \text{ CFS}$$

MICHAEL BAKER, JR., INC.
| THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Lake Timberline Dam S.O. No. _____
100-Year Discharge Correlation Sheet No. 6 of 6
Drawing No. _____
Computed by GWT Checked by WDL Date 7/10/81

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "WATER RESOURCES BULLETIN, BULLETIN NO. 13, FLOODS IN PENNSYLVANIA", PREPARED BY THE DEPARTMENT OF ENVIRONMENTAL RESOURCES, COMMONWEALTH OF PENNSYLVANIA.

DEBRIS FLOW BASIN FROM PLATE 2 = MODEL Z

REGRESSION EQUATION FROM TABLE

$$Q_T = cA^*$$

T = 100 YEARS

C-564

A = DRAINAGE AREA, 1.28 Sq. Mi.

x = .744

$$Q_{100} = 56 + (1.28)^{.744}$$

$$Q_{100} = 678 \text{ C.F.S.}$$

AVERAGING THE INFLOW FROM THIS METHOD AND
THE PREVIOUS METHOD GIVES AN INFLOW OF 1,030 G.P.S.
TO THE IMPOUNDMENT.

APPENDIX E

PLATES

CONTENTS

Plate 1 - Location Plan

Plate 2 - Watershed Map

Plate 3 - Location and Plot Plan Drawing

Plate 4 - Plan of Spillway and Section Through Embankment

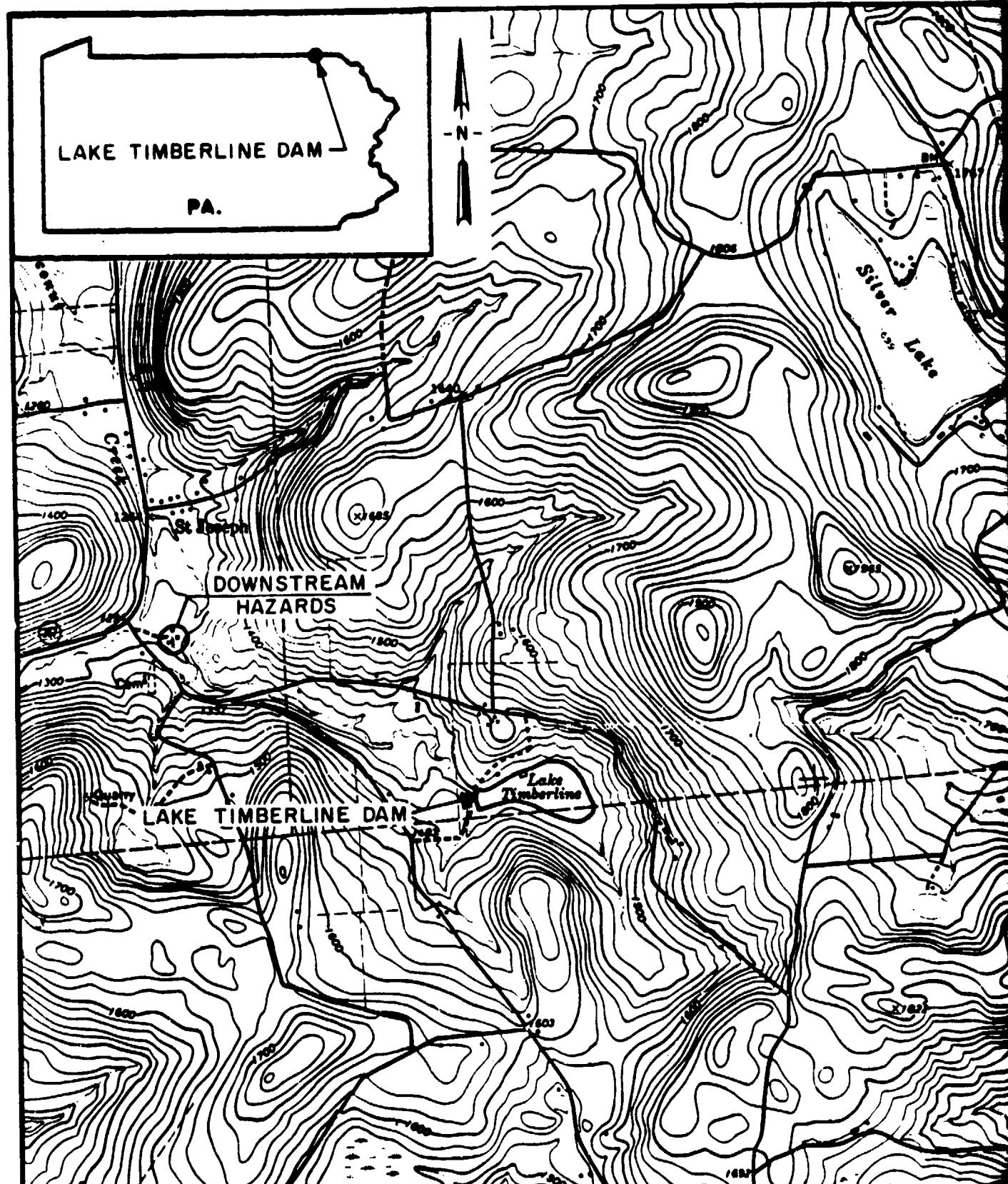
Plate 5 - Spillway Details

Plate 6 - Drawdown Details

Plate 7 - Cross-Sections

Plate 8 - Cross-Sections

Plate 9 - Cross-Sections



SCALE 1:24000

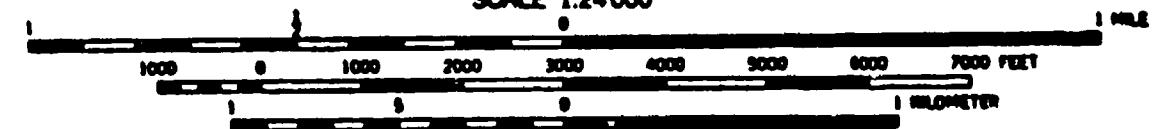
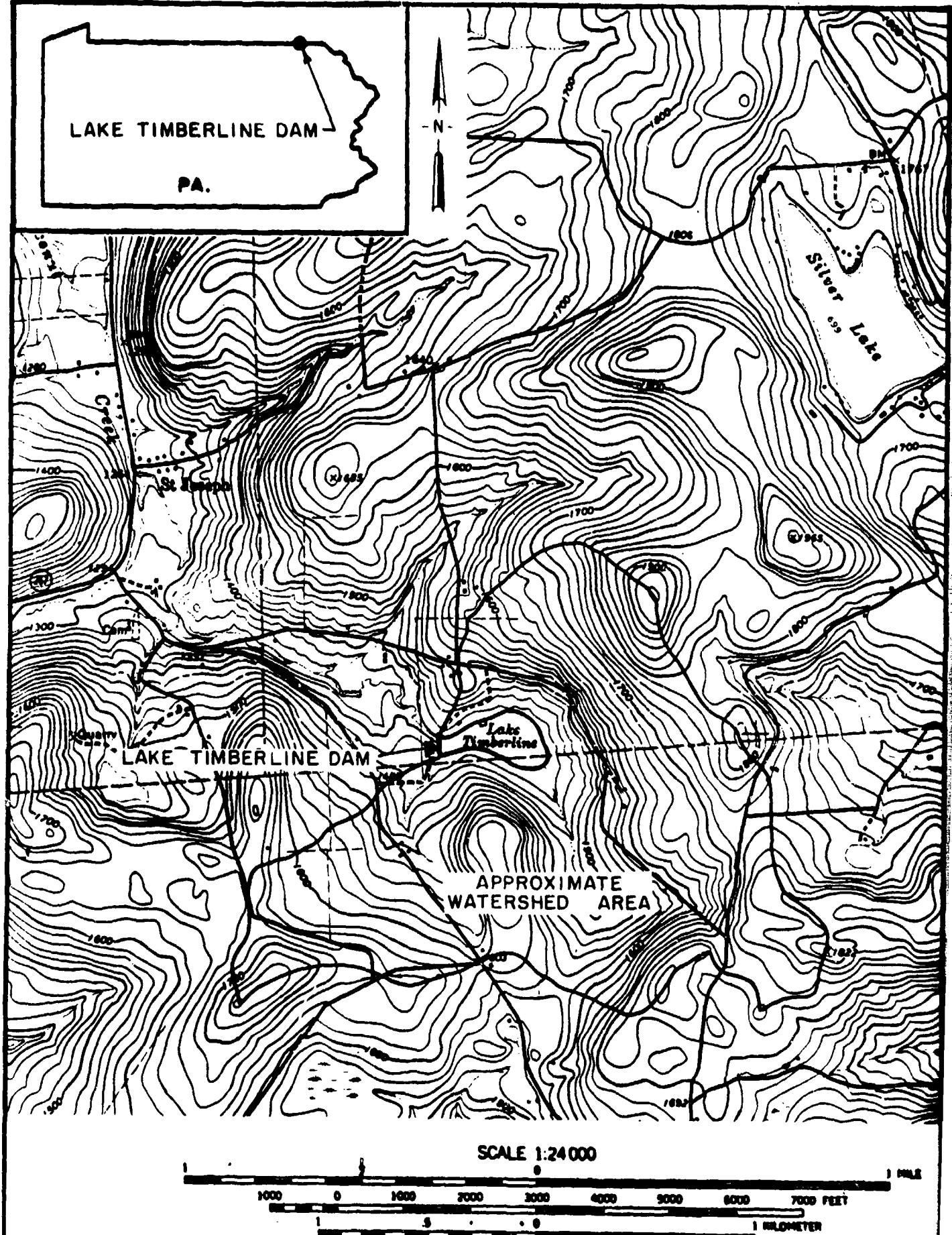


PLATE I LOCATION PLAN

REFERENCES:

1. U.S.G.S. 7.5' LAUREL LAKE, PA.-N.Y.
QUADRANGLE. 1966

LAKE TIMBERLINE DAM



SCALE 1:24 000

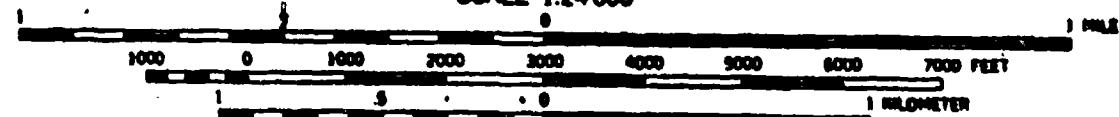
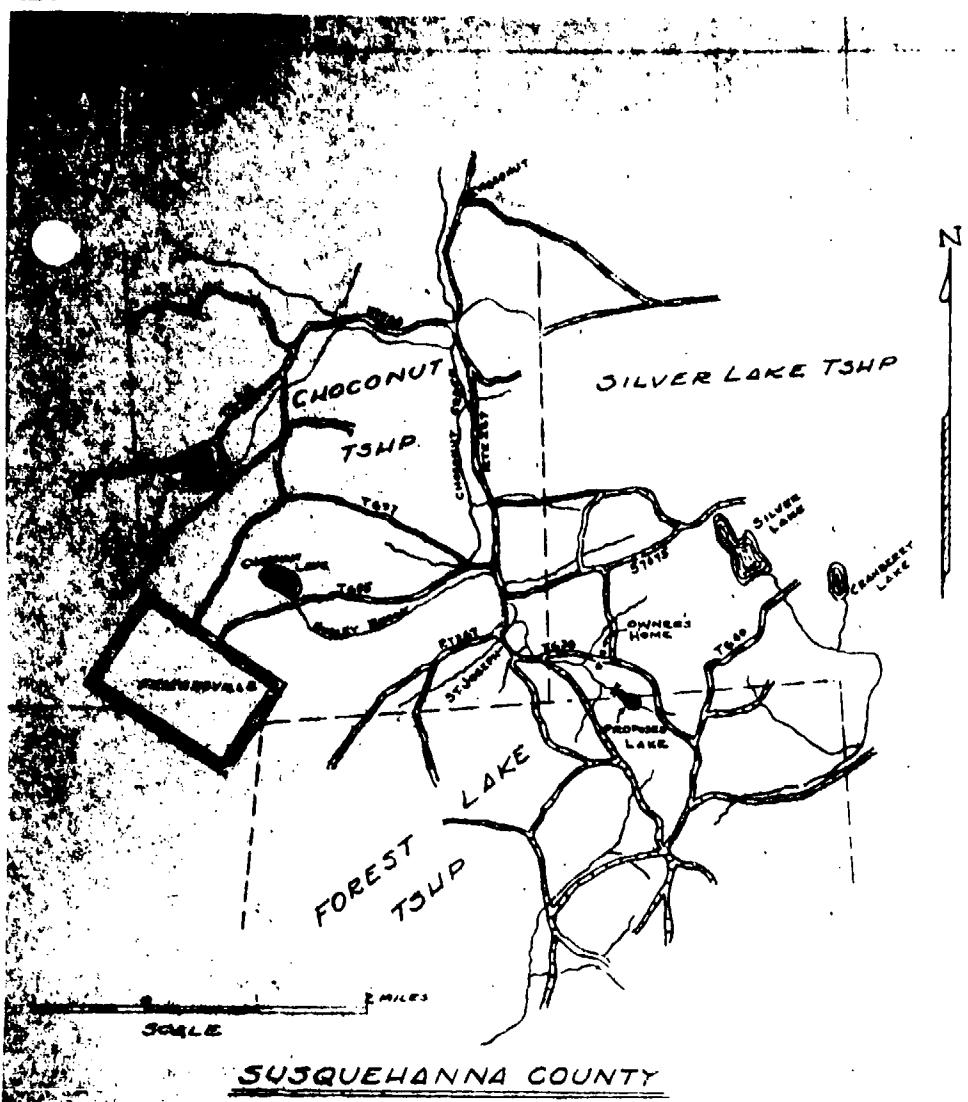


PLATE 2 WATERSHED MAP

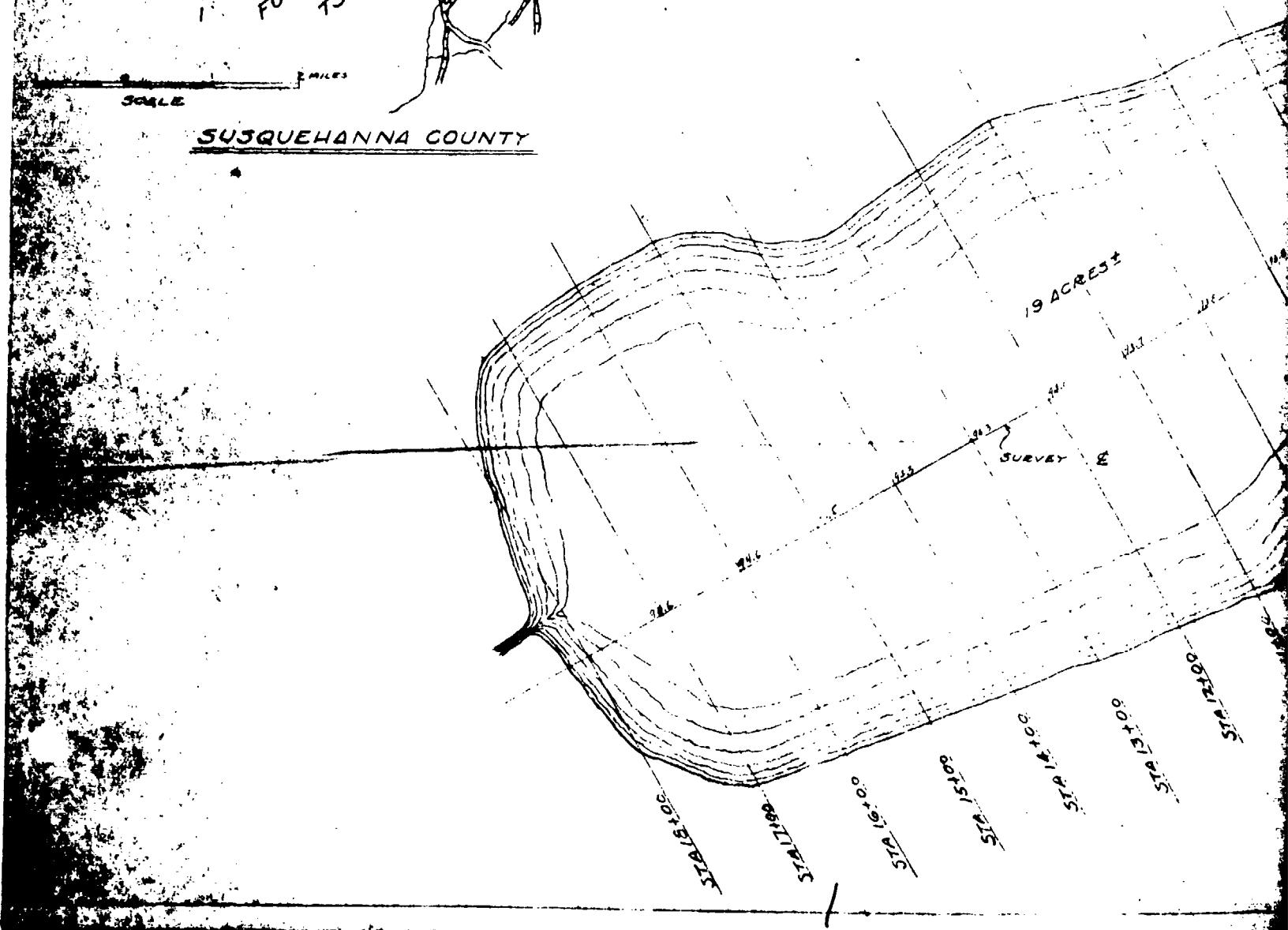
LAKE TIMBERLINE DAM

REFERENCES:

1. U.S.G.S. 7.5' LAUREL LAKE, PA.-N.Y.
QUADRANGLE E. 1968



SUSQUEHANNA COUNTY



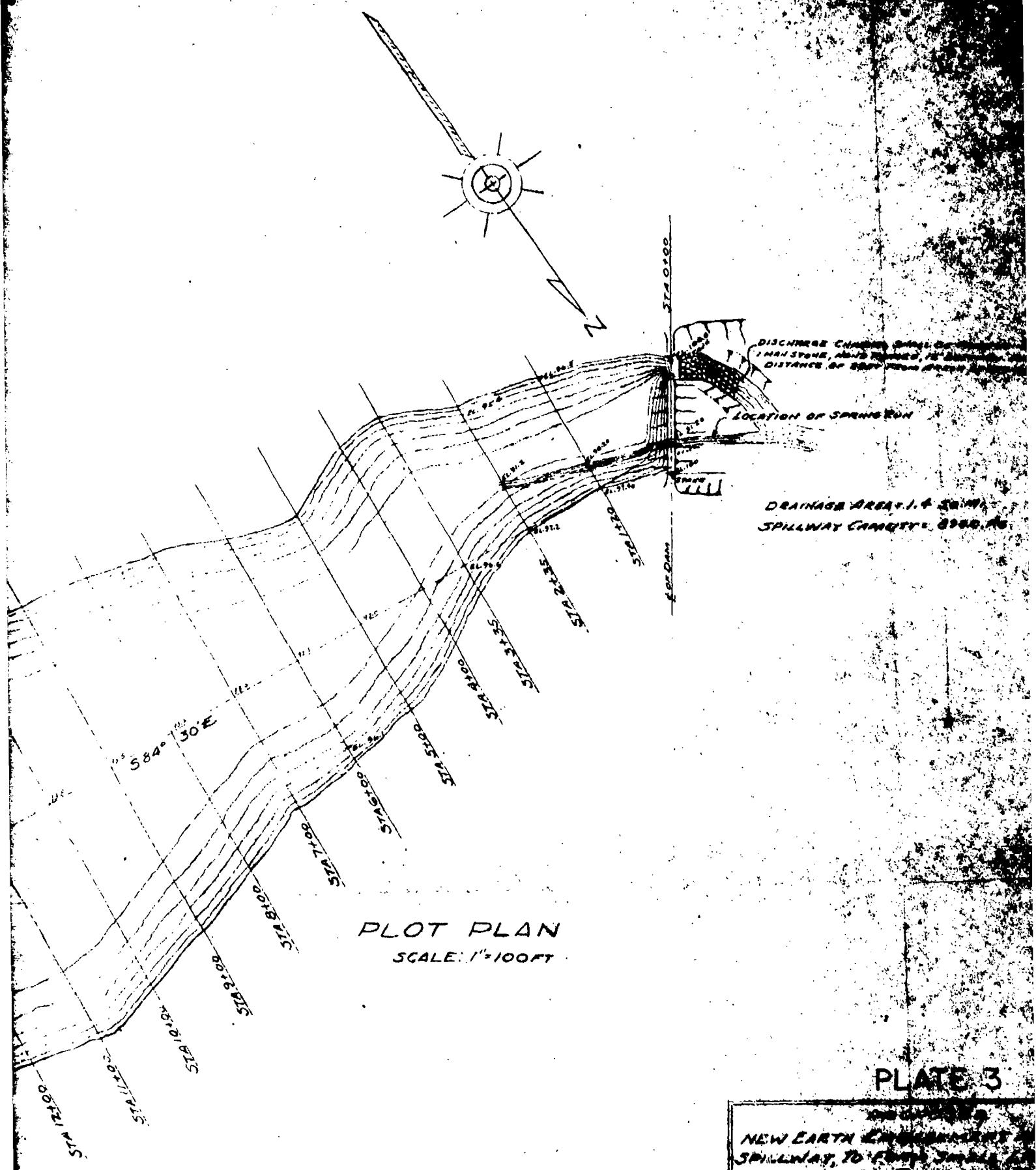
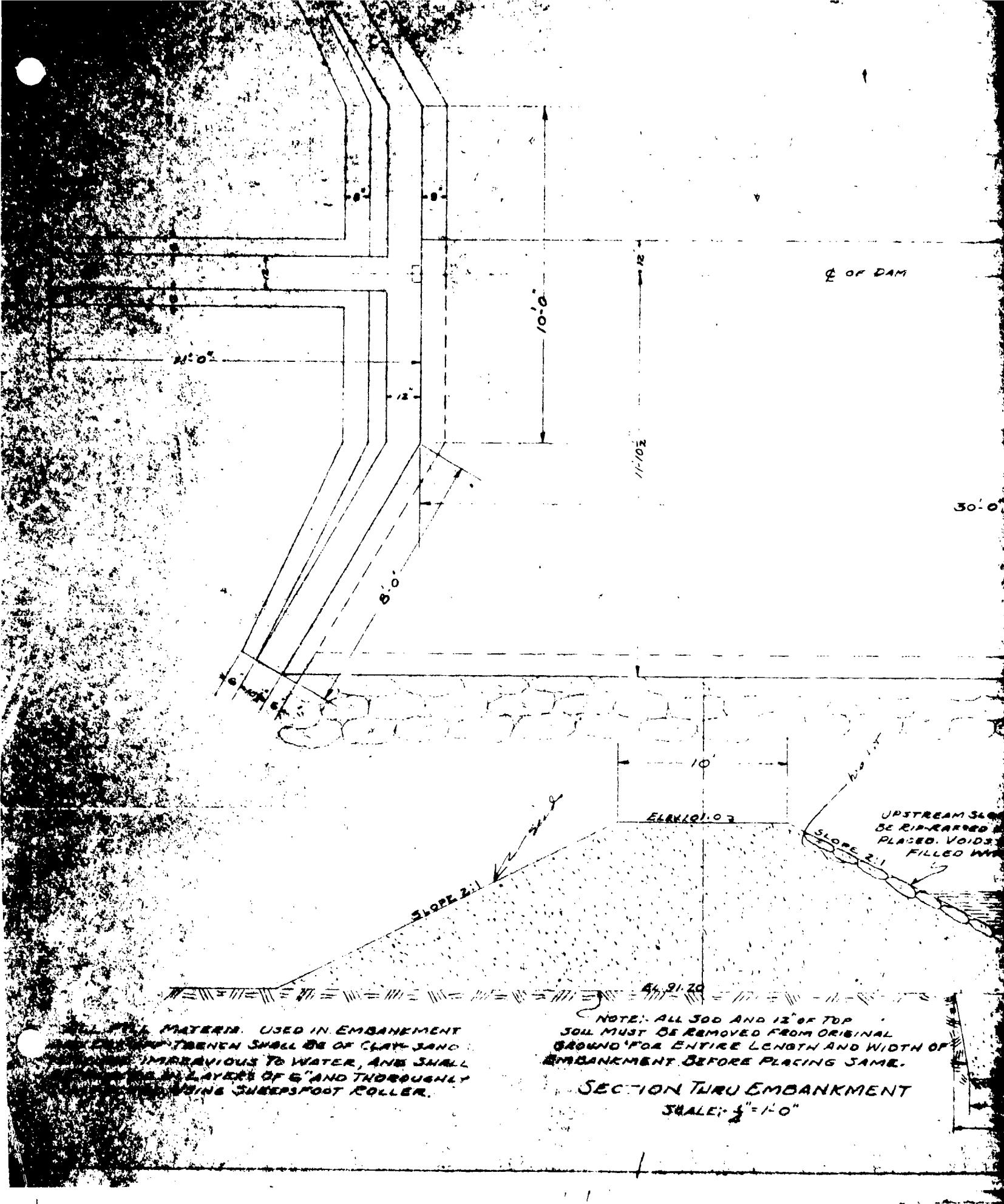


PLATE 3

NEW EARTH COMMUNION
SPILLWAY, TO FORT ST. JAMES
PROPERTY OF THE
ST. JOSEPH JESUIT MISSION
OWNER: AVAIL
JUNE 1982



WAY

30'-0"

6'-0"

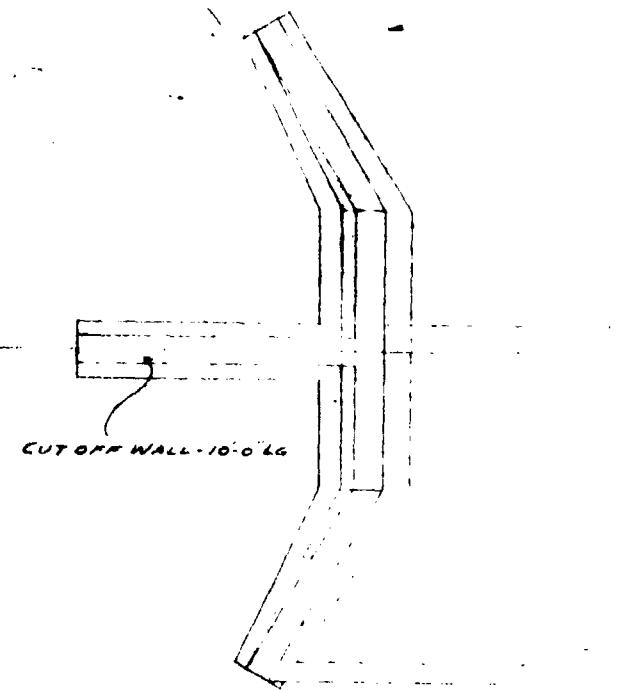
10'

STREAM SLOPE OF CEMBANKMENT SHALL
BE RAPED USING ONE MAN STONE, HAND
NO. Voids between stones shall be
filled with cracked stone.

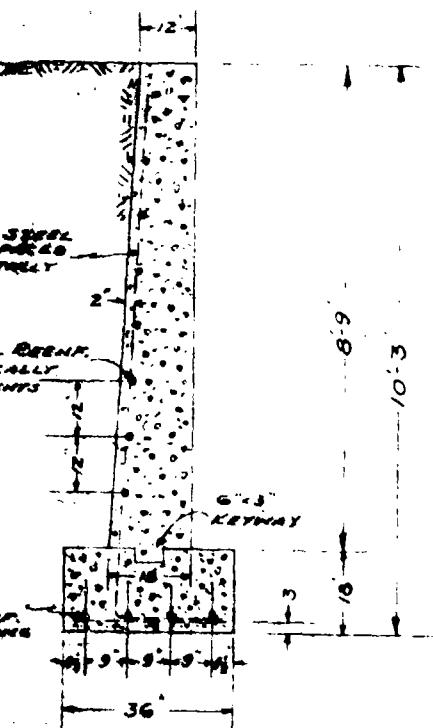
WATER ELEV. 97.0

TOP

6' 10'



PLAN
3'-0"



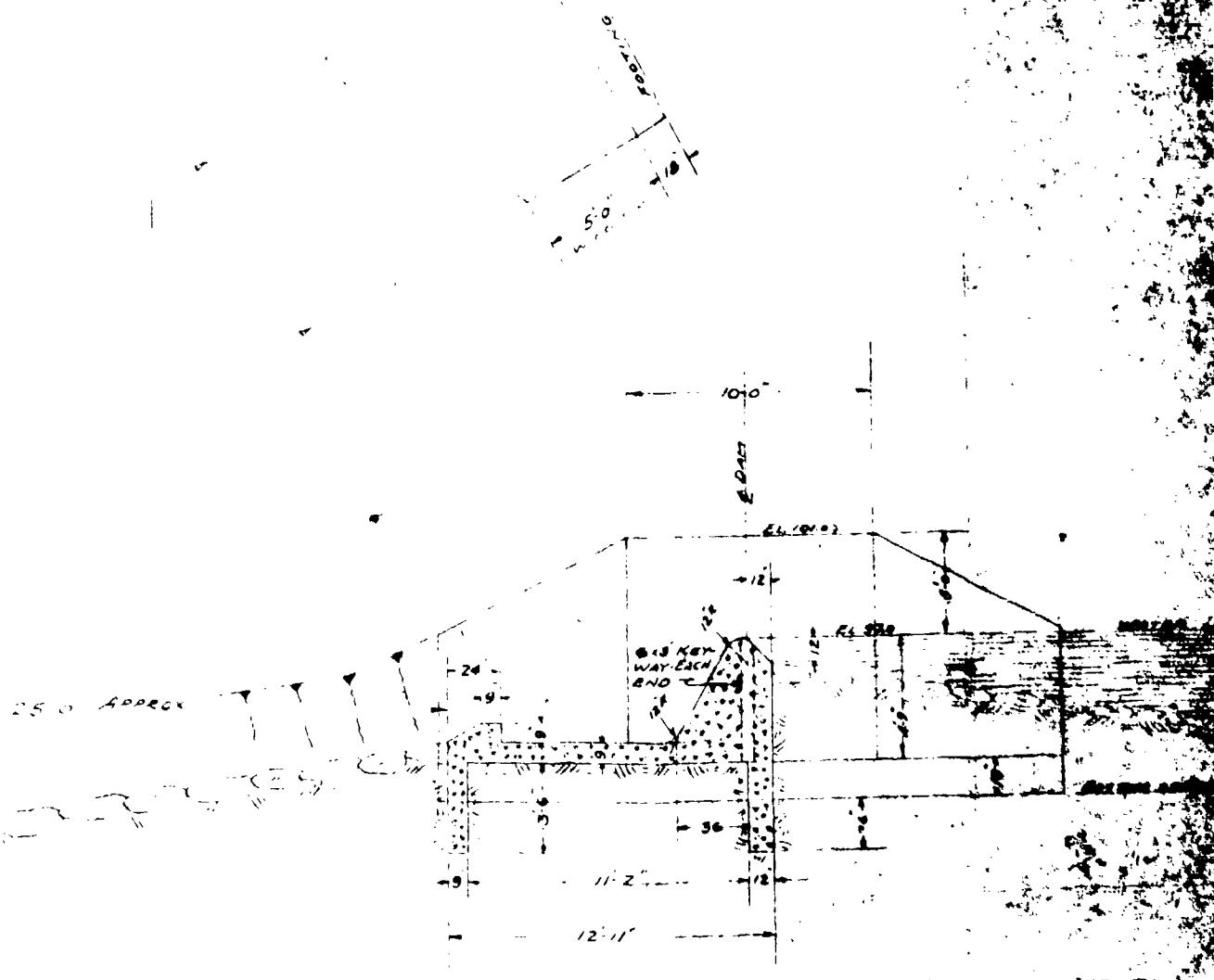
SECTION THRU ABUTMENT WALL
SCALE: 1'-0"
2"



SECTION THRU CUT-OFF WALL
SCALE: 1'-0"
2"

NOTES

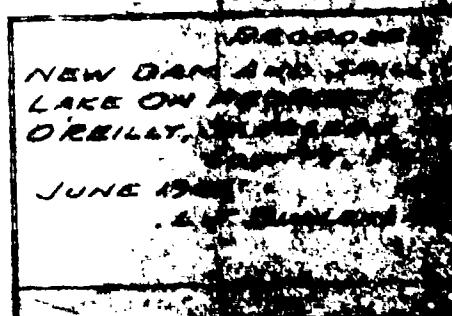
- 1 ALL CONCRETE TO BE 1:2:4 MIX
- 2 ALL SAND SHOULD BE FINE
3. ALL COARSE AGGREGATE SHOULD BE CLEAN STONE OR CRUSHED STONE
- 4 ALL REINFORCING STEEL SHOULD BE SPEC ASTM-A-315-527 & A-80
5. USE ONLY CLEAR, GROUND DRA

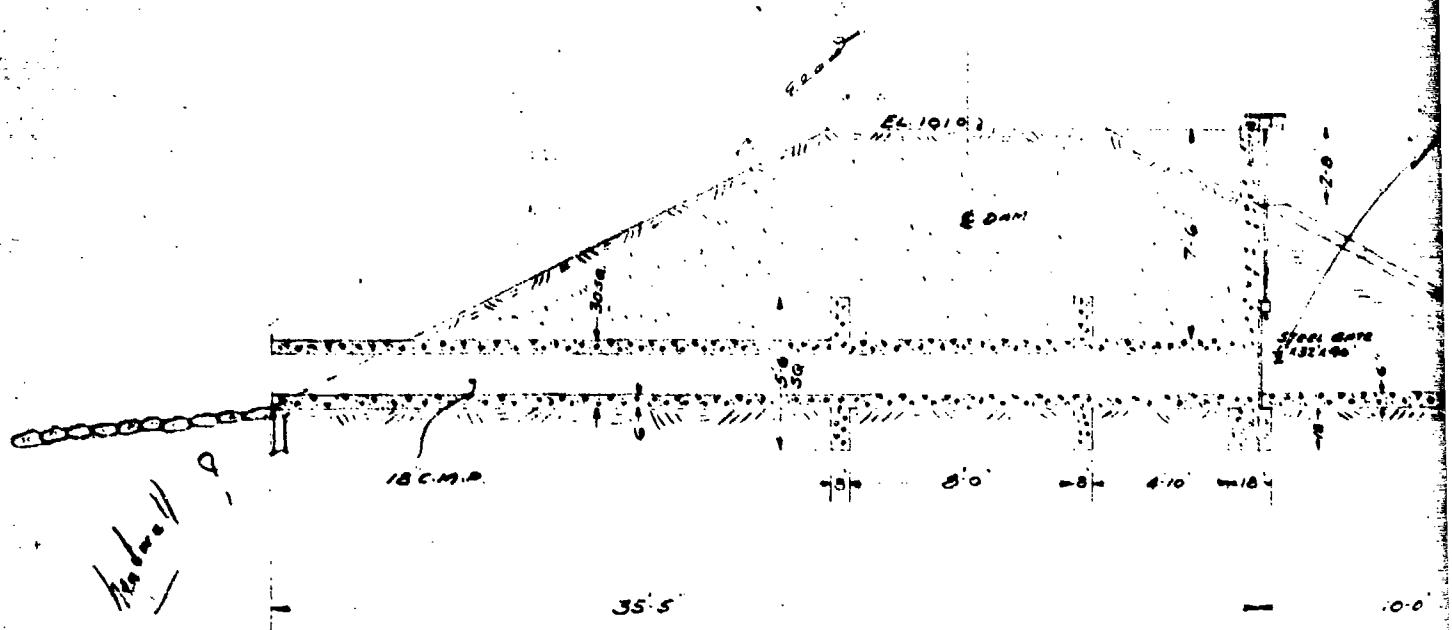


SECTION THRU SPILLWAY PARIR
SCALE: $\frac{1}{2}$ " = 10'

SPILLWAY DETAILS

PLATE 5



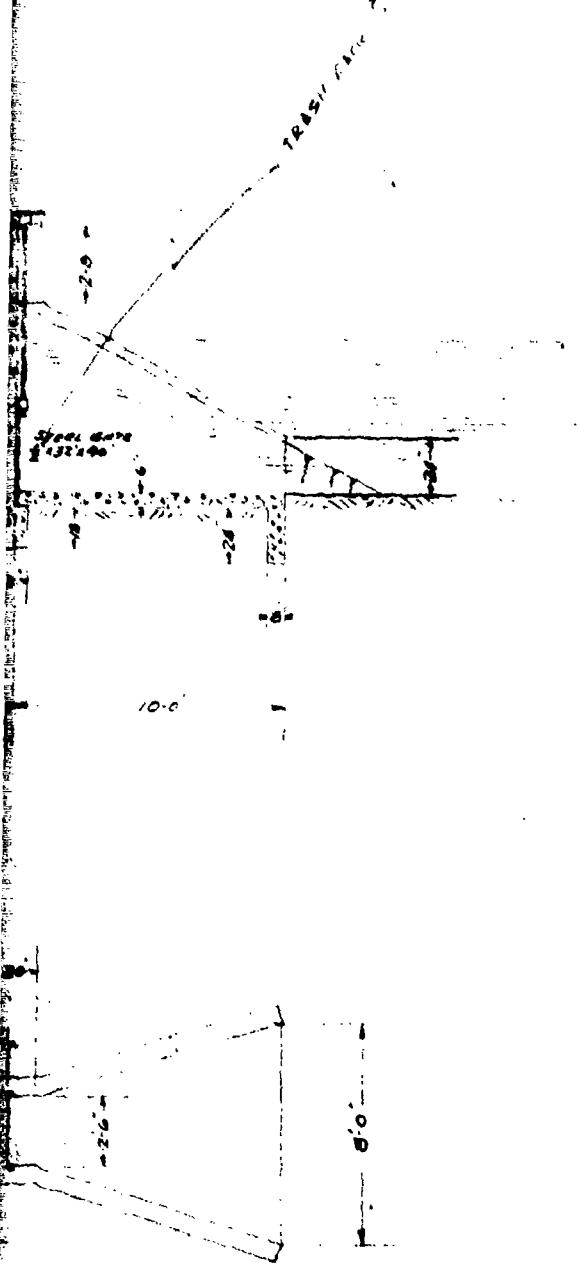


SECTION THRU EMBANKMENT



PLAN

DRA

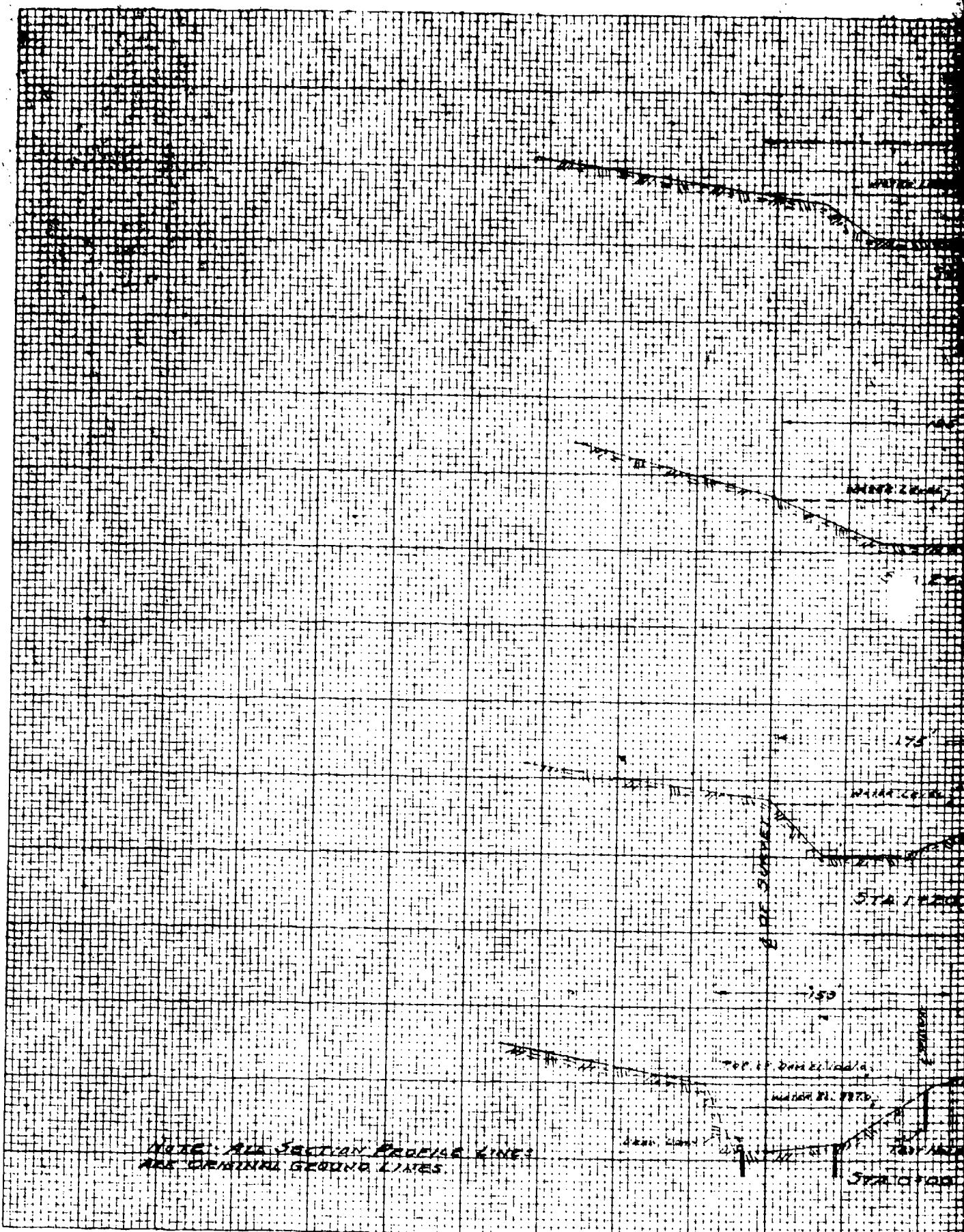


DRAW DOWN DETAILS
SCALE: 1"-0"

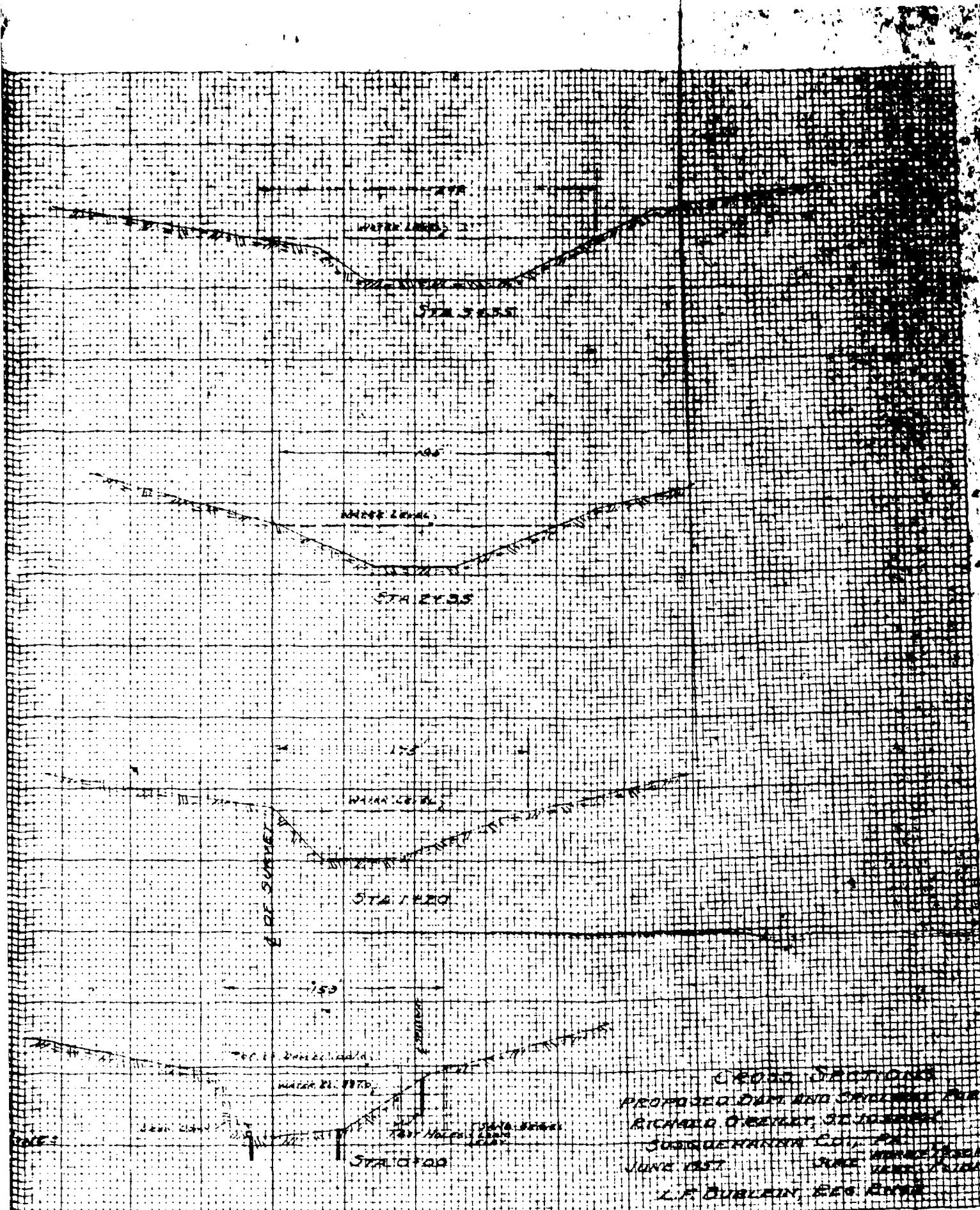
PLATE 6

PROPOSED
NEW DAM AND SPILLWAY
ON PROPERTY OF
O'BILLY, ST. JOHNS,
CONNECTICUT
JUNE 1954

2



PREFERRED CROSS SECTION
10X10 TO ONE INCH
No. 503

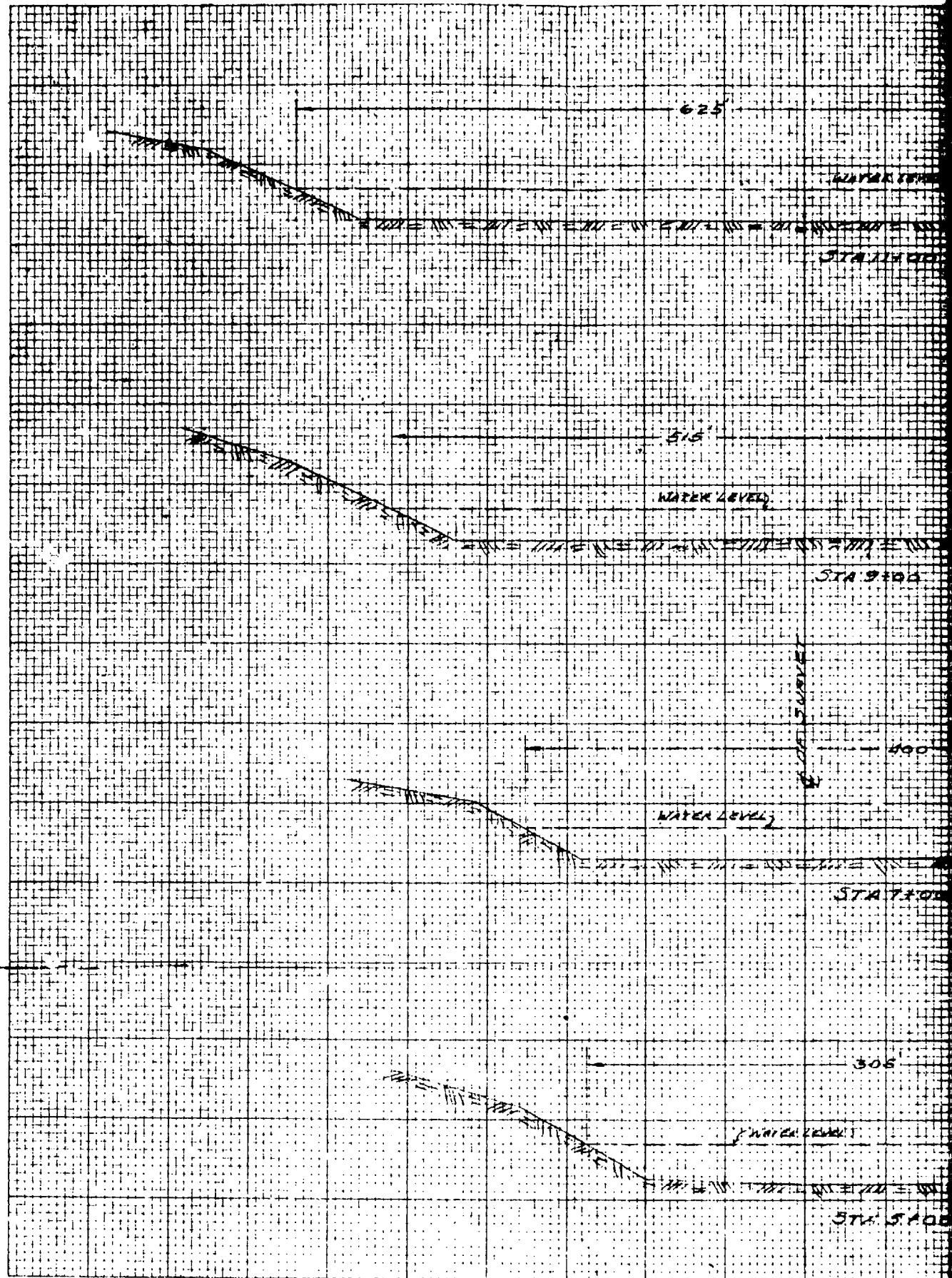


PREFERRED CROSS SECTION
10' x 10' ONE INCH
No. 503

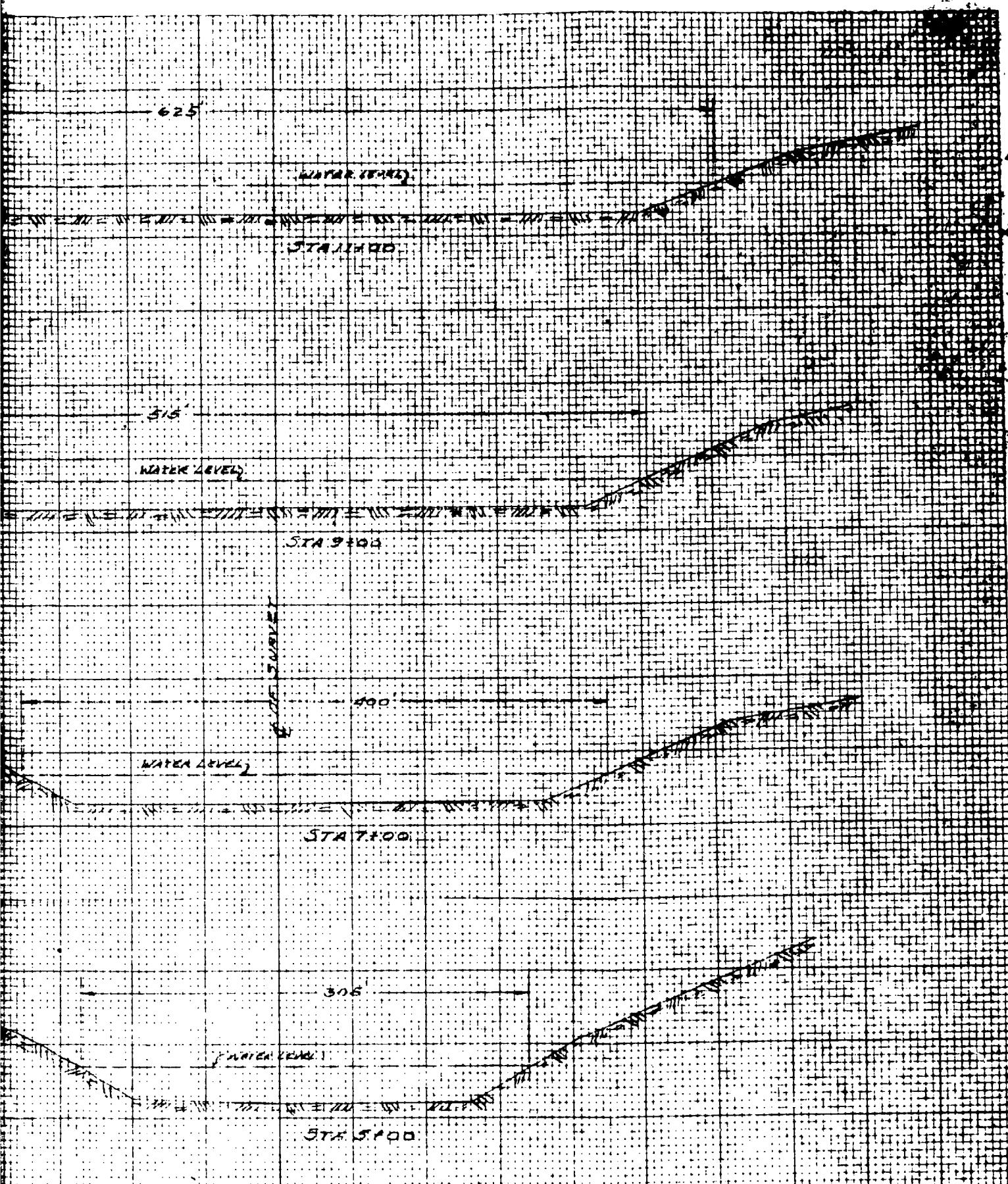
RECORDED DIRECTORIAL
PROPOSAL DRAFT AND CHANGES
RICARDO D'ESTRELLA, SC. JUN 1957
SUSAN DEHARVE CO., INC.
JUNE 1957
L. P. BURLIN, REG. FOR

THE "REDWOOD POST CO CHICAGO
SHEET NO 5 OF 7

PLATE 7



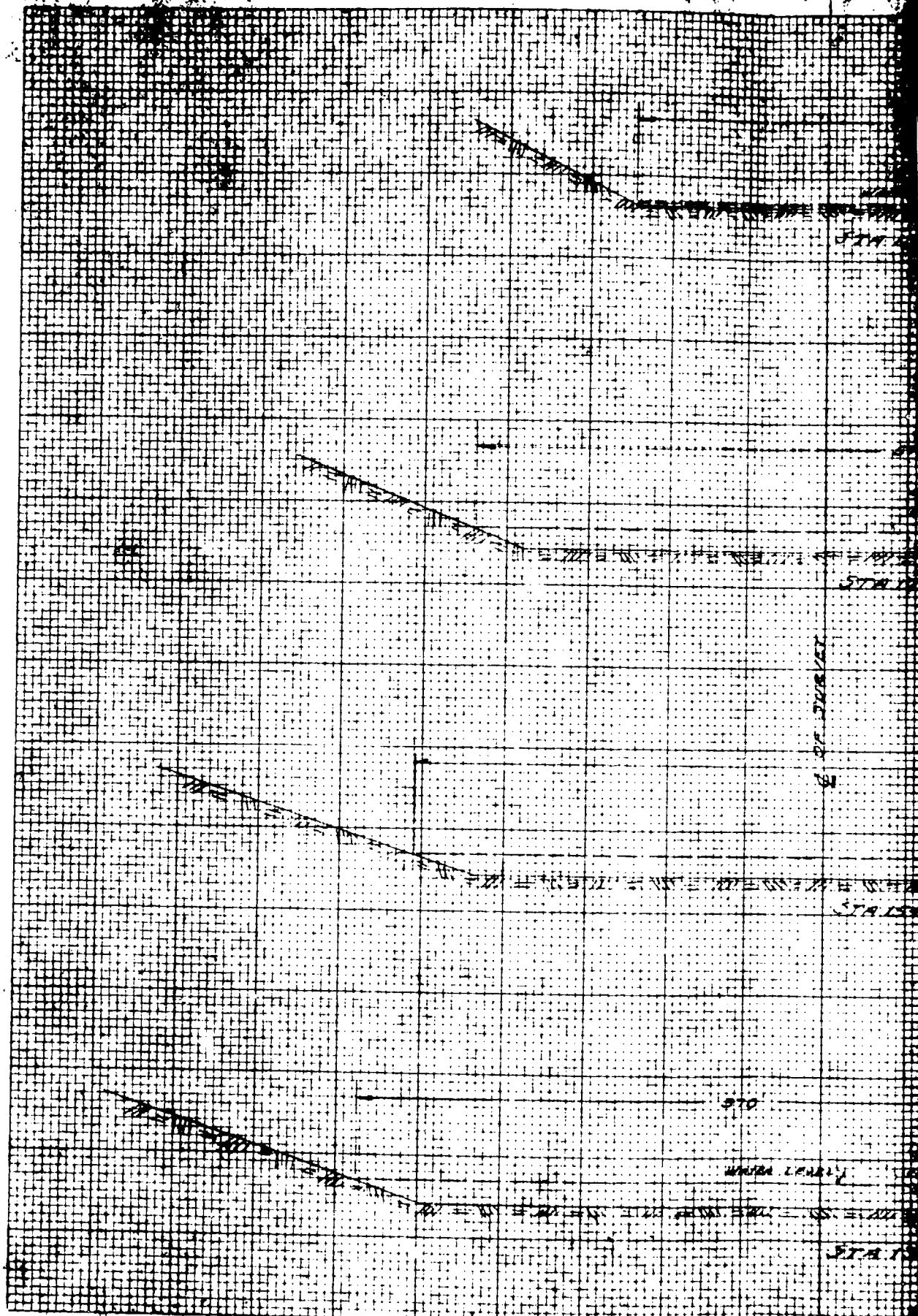
PREFERRED CROSS SECTION
10' TO ONE INCH
No 503



PREFERRED CROSS SECTION
10'10 TO ONE INCH
No 503

INT PREDERICA PORT O CHAMBO
SHEET NO 6 OF 7

PLATE 8



PREFERRED CROSS SECT
10x10 TO ONE INCH
No. 360

三

WILSON LIBRARY

卷之三

PREFERRED CROSS SECTION

10-10 TO ONE INCH

四

THE FREDERICK POLK CO.
SAGE & JAMES

PLATE 9.

APPENDIX F
REGIONAL GEOLOGY

Lake Timberline Dam
NDI No. PA 00977, PennDER No. 58-125

REGIONAL GEOLOGY

Lake Timberline Dam is located in the glaciated northeast section of the Appalachian Plateaus physiographic province. The impounded lake occupies the middle of an unnamed stream valley. The lake is fed by drainage from two intermittent streams. Drainage from the lake flows to the west where it eventually forms a confluence with Choconut Creek. Choconut Creek, in turn, flows to the Susquehanna River. The average topographic relief from the hilltops to the Choconut Stream Valley is 500 feet.

The study area has been glaciated at least three times and is presently overlaid by the glacial ground moraine of the Nebraskan, Kansan, and Wisconsin glaciations. Three borings were performed along the centerline of the dam. One boring indicated "sand-gravel, loam clay." Additional information other than the information presented for these three was unavailable for review; and the information from these three borings is considered meager. Therefore, the extent and thickness of the soil types is difficult to ascertain. According to the Soil Conservation Service survey for Susquehanna County, soils in the vicinity of the lake consist of Volusia flaggy to channery silt loams on slopes that range from 8 to 25 percent.

Geologic data taken from the Geologic Map of Pennsylvania indicates that bedrock in the vicinity of the lake is composed of rocks of the Devonian Susquehanna Group. Bedrock of this group has been subdivided in other sections of the state into the Marine Beds, the Catskill Formation, and the Oswayo Formation. The rocks underlying the dam are most likely of the Catskill Formation. This formation is composed chiefly of red to brownish shales and sandstones; including gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.



**GEOLOGIC MAP
Lake Timberline Dam
NDI No. PA 00977, Susquehanna County**

**Reproduced from Geologic Map of Pennsylvania,
Pennsylvania Geological Survey, 4th Series**

Scale: One Inch Equals Approximately Four Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

DEVONIAN UPPER

WESTERN PENNSYLVANIA



Oswayo Formation

Greenish gray to gray shales, siltstones and sandstones becoming increasingly shaly westward, considered equivalent to type Osceola, Rieeville Formation Dl in Erie and Crawford Counties, probably not distinguishable north of Corry.



Cattaraugus Formation

Red, gray and brown shale and sandstone with the proportion of red decreasing westward, includes Venango sands of drifters and Salamanca sandstone and conglomerate, some limestone in Crawford and Erie counties.



Conneaut Group

Alternating gray, brown, greenish and purplish shales and siltstones; includes "pink rock" of drifters and "Chemung" and "Girard" Formations of northwest Pennsylvania.



Canadaway Formation

Alternating brown shales and sandstones, includes "Portage" Formation of northwestern Pennsylvania.

CENTRAL AND EASTERN PENNSYLVANIA



Oswayo Formation

Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered carbonaceous lenses, includes red shales which become more numerous eastward. Relation to type Oswayo not proved.



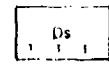
Catskill Formation

Charly red to brownish shales and sandstones, includes gray and greenish sandstone tongue named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.



Murine beds

Gray to olive brown shales, grainstones and sandstones, contains "Chemung" beds and "Portage" beds including Bucket Hole, Howell, and Trimmers Rock, Tidyl Limestone at base.



Susquehanna Group

Barbed line in "Chemung-Catskill" contact of Second Pennsylvania Survey County reports, barbs on "Chemung" side of line.

MIDDLE AND LOWER

Hamilton Group



Dh

Mahantango Formation

Brown to olive shale with interbedded sandstones which are dominant in places (Montebello); highly fossiliferous in upper part, contains "Centerfield coral bed" in eastern Pennsylvania.



Marcellus Formation

Black, fissile, carbonaceous shale with thick, brown sandstone (Turkey Ridge) in parts of central Pennsylvania.



Onondaga Formation

Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places, includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in southeastern Pennsylvania, in Lehigh Gap area includes Palmerston Sandstone and Bowmanstown Chert.



Dmo



Do

Oriskany Formation

White to brown, fine to coarse grained, partly carbonaceous, locally conglomeratic, fossiliferous sandstone (Kingsley) at the top; dark gray, charky, thin bedded, fossiliferous limestone (New Scotland) with some local sandstones in the middle, and, at the base, dark gray, medium to thick bedded, fossiliferous limestone (Cayugan), sandy and shaly in places with some chert nodules.



Dhb

Helderberg Formation

Dark gray, carbonaceous, thin bedded shale (Mandata) at the top, equivalent to Port Ewen Shale and Bennett Limestone in the east, dark gray, charky, thin bedded, fossiliferous limestone (New Scotland) with some local sandstones in the middle, and, at the base, dark gray, medium to thick bedded, fossiliferous limestone (Cayugan), sandy and shaly in places with some chert nodules.